PEMBELAJARAN BERBASIS MASALAH (PROBLEM-BASED LEARNING)

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APAKAH PEMBELAJARAN BERBASIS MASALAH (PBL) ITU?

Untuk meningkatkan kualitas proses dan hasil belajar, para ahli pembelajaran telah menyarankan penggunaan paradigma pembelajaran konstruktivistik untuk kegiatan belajar-mengajar di kelas. Dengan perubahan paradigma belajar tersebut terjadi perubahan pusat (fokus) pembelajaran dari belajar berpusat pada guru kepada belajar berpusat pada siswa. Dengan kata lain, ketika mengajar di kelas, guru harus berupaya menciptakan kondisi lingkungan belajar yang dapat membelajarkan siswa, dapat mendorong siswa belajar, atau memberi kesempatan kepada siswa untuk berperan aktif mengkonstruksi konsep-konsep yang dipelajarinya. Kondisi belajar dimana siswa/mahasiswa hanya menerima materi dari pengajar, mencatat, dan menghafalkannya harus diubah menjadi sharing pengetahuan, mencari (inkuiri), menemukan pengetahuan secara aktif sehingga terjadi peningkatan pemahaman (bukan ingatan). Untuk mencapai tujuan tersebut, pengajar dapat menggunakan pendekatan, strategi, model, atau metode pembelajaran inovatif.
Pembelajaran berbasis masalah (Probelem-based learning), selanjutnya disingkat PBL, merupakan salah satu model pembelajaran inovatif yang dapat memberikan kondisi belajar aktif kepada siswa. PBL adalah suatu model pembelajaran yang melibatkan siswa untuk memecahkan suatu masalah melalui tahap-tahap metode ilmiah sehingga siswa dapat mempelajari pengetahuan yang berhubungan dengan masalah tersebut dan sekaligus memiliki ketrampilan untuk memecahkan masalah (Ward, 2002; Stepien, dkk.,1993). Lebih lanjut Boud dan felleti, (1997), Fogarty(1997) menyatakan bahwa PBL adalah suatu pendekatan pembelajaran dengan membuat konfrontasi kepada pebelajar (siswa/mahasiswa) dengan masalah-masalah praktis, berbentuk *ill-structured*, atau *open ended* melalui stimulus dalam belajar. PBL memiliki karakteristik-karakteristik sebagai berikut: (1) belajar dimulai dengan suatu masalah, (2) memastikan bahwa masalah yang diberikan berhubungan dengan dunia nyata siswa/mahasiswa, (3) mengorganisasikan pelajaran diseputar masalah, bukan diseputar disiplin ilmu, (4) memberikan tanggung jawab yang besar kepada pebelajar dalam membentuk dan menjalankan secara langsung proses belajar mereka sendiri, (5) menggunakan kelompok kecil, dan (6) menuntut pebelajar untuk mendemontrasikan apa yang telah mereka pelajari dalam bentuk suatu produk atau kinerja. Berdasarkan uraian tersebut tampak jelas bahwa pembelajaran dengan model PBL dimulai oleh adanya masalah (dapat dimunculkan oleh siswa atau guru), kemudian siswa memperdalam pengetahuannya tentang apa yang mereka telah ketahui dan apa yang mereka perlu ketahui untuk memecahkan masalah tersebut. Siswa dapat memilih masalah yang dianggap menarik untuk dipecahkan sehingga mereka terdorong berperan aktif dalam belajar.

Masalah yang dijadikan sebagai fokus pembelajaran dapat diselesaikan siswa melalui kerja kelompok sehingga dapat memberi pengalaman-pengalaman belajar yang beragam pada siswa seperti kerjasama dan interaksi dalam kelompok, disamping pengalaman belajar yang berhubungan dengan pemecahan masalah seperti membuat *hipotesis, merancang percobaan, melakukan penyelidikan, mengumpulkan data, menginterpretasikan data, membuat kesimpulan, mempresentasikan, berdiskusi, dan membuat laporan.* Keadaan tersebut menunjukkan bahwa model PBL dapat memberikan pengalaman yang kaya kepada siswa. Dengan kata lain, penggunaan PBL dapat meningkatkan pemahaman siswa tentang apa yang mereka pelajari sehingga diharapkan mereka dapat menerapkannya dalam kondisi nyata pada kehidupan sehari-hari.

MENGAPA MENGGUNAKAN PBL?

PBL merupakan model pembelajaran yang berorientasi pada kerangka kerja teoritik konstruktivisme. Dalam model PBL, fokus pembelajaran ada pada masalah yang dipilih sehingga pebelajar tidak saja mempelajari konsep-konsep yang berhubungan dengan masalah tetapi juga metode ilmiah untuk memecahkan masalah tersebut. Oleh sebab itu, pebelajar tidak saja harus memahami konsep yang relevan dengan masalah yang menjadi pusat perhatian tetapi juga memperoleh pengalaman belajar yang berhubungan dengan ketrampilan menerapkan metode ilmiah dalam pemecahan masalah dan menumbuhkan pola berpikir kritis.

Bila pembelajaran yang dimulai dengan suatu masalah, apalagi kalau masalah tersebut bersifat kontekstual, maka dapat terjadi ketidaksetimbangan kognitif pada diri pebelajar. Keadaan ini dapat mendorong rasa ingin tahu sehingga memunculkan bermacam-macam pertanyaan disekitar masalah seperti “apa yang dimaksud dengan….”, “mengapa bisa terjadi….”, “bagaimana mengetahuinya…” dan seterusnya. Bila pertanyaan-pertanyaan tersebut telah muncul dalam diri pebelajar maka motivasi intrinsik mereka untuk belajar akan tumbuh. Pada kondisi tersebut diperlukan peran guru sebagai fasilitator untuk mengarahkan pebelajar tentang “konsep apa yang diperlukan untuk memecahkan masalah”, “apa yang harus dilakukan” atau “bagaimana melakukannya” dan seterusnya. Dari paparan tersebut dapat diketahi bahwa penerapan PBL dalam pembelajaran dapat mendorong siswa/mahasiswa mempunyai inisiatif untuk belajar secara mandiri. Pengalaman ini sangat diperlukan dalam kehidupan sehari-hari dimana berkembangnya pola pikir dan pola kerja seseorang bergantung pada bagaimana dia membelajarkan dirinya.

Lebih lanjut Arends (2004) menyatakan bahwa ada tiga hasil belajar (outcomes) yang diperoleh pebelajar yang diajar dengan PBL yaitu:

(1) inkuiri dan ketrampilan melakukan pemecahan masalah,

(2) belajar model peraturan orang dewasa (adult role behaviors), dan

(3) ketrampilan belajar mandiri (skills for independent learning).

Inkuiri dan ketrampilan proses dalam pemecahan masalah telah dipaparkan sebelumnya. Siswa yang melakukan inkuiri dalam pempelajaran akan menggunakan ketrampilan berpikir tingkat tinggi (higher-order thinking skill) dimana mereka akan melakukan operasi mental seperti induksi, deduksi, klasifikasi, dan reasoning. PBL juga bertujuan untuk membantu pebelajar siswa/mahasiswa belajar secara mandiri.

Pembelajaran PBL dapat diterapkan bila didukung lingkungan belajar yang konstruktivistik. Lingkungan belajar konstruktivistik mencakup beberapa faktor yaitu (Jonassen dalam Reigeluth (Ed), 1999:218): kasus-kasus berhubungan, fleksibelitas kognisi, sumber-sumber informasi, cognitive tools, pemodelan yang dinamis, percakapan dan kolaborasi, dan dukungan sosial dan kontekstual.

Kasus-kasus berhubungan, membantu pebelajar untuk memahami pokok-pokok permasalahan secara implisit. Kasus-kasus berhubungan dapat membantu siswa/mahasiswa belajar mengidentifikasi akar masalah atau sumber masalah utama yang berdampak pada munculnya masalah yang lain. Kegiatan belajar seperti itu dapat membantu pebelajar meningkatkan kemampuan berpikir kritis yang sangat berguna dalam kehidupan sehari-hari.

Fleksibelitas kognisi merepresentasi materi pokok dalam upaya memahami kompleksitas yang berkaitan dengan domain pengetahuan. Fleksibelitas kognisi dapat ditingkatkan dengan memberikan kesempatan bagi pebelajar untuk memberikan ide-idenya, yang menggambarkan pemahamannya terhadap permasalahan. Fleksibelitas kognisi dapat menumbuhkan kreativitas berpikir divergen didalam mempresentasikan masalah. Dari masalah yang siswa/mahasiswa tetapkan, mereka dapat mengembangkan langkah-langkah pemecahan masalah, mereka dapat mengemukakan ide pemecahan yang logis. Ide-ide tersebut dapat didiskusikan dahulu dalam kelompok kecil sebelum dilaksanakan.

Sumber-sumber informasi, bermanfaat bagi pebelajar dalam menyelidiki permasalahan. Informasi dikonstruksi dalam model mental dan perumusan hipotesis yang menjadi titik tolak dalam memanipulasi ruang permasalahan. Dalam konteks belajar sains (kimia), pengetahuan sains yang dimiliki siswa terhadap masalah yang dipecahkan dapat digunakan sebagai acuan awal dan dalam penelusuran bahan pustaka sesuai dengan masalah yang mereka pecahkan.

Cognitive tools, merupakan bantuan bagi pelajar untuk meningkatkan kemampuan menyelesaikan tugas-tugasnya. Cognitive tools membantu pebelajar untuk merepresentasi apa yang diketahuinya atau apa yang dipelajarinya, atau melakukan aktivitas berpikir melalui pemberian tugas-tugas.

Pemodelan yang dinamis, adalah pengetahuan yang memberikan cara-cara berpikir dan menganalisis, mengorganisasi, dan memberikan cara untuk mengungkapkan pemahaman mereka terhadap suatu fenomena. Pemodelan membantu mahasiswa untuk menjawab pertanyaan-pertanyaan, “apa yang saya ketahui” dan “apa artinya”.

Percakapan dan kolaborasi, dilakukan dengan diskusi dalam proses pemecahan masalah. Diskusi secara tidak resmi dapat menumbuhkan suasana kolaborasi. Diskusi yang intensif dimana terjadi proses menjelaskan dan memperhatikan penjelasan peserta diskusi dapat membatu siswa mengembangkan komunikasi ilmiah, argumentasi yang logis, dan sikap ilmiah.

Dukungan sosial dan kontekstual, berhubungan dengan bagaimana masalah yang menjadi fokus pembelajaran dapat membuat pebelajar termotivasi untuk memecahkannya. Dukungan sosial dalam kelompok, adanya kondisi yang saling memotivasi antar

pebelajar dapat menumbuhkan kondisi ini. Suasana kompetitif antar kelompok juga dapat mendukung kinerja kelompok. Dukungan sosial dan kontekstual hendaknya dapat diakomodasi oleh para guru/dosen untuk mensukseskan pelaksanaan pembelajaran. Berdasarkan uraian di atas dapat dikemukakan bahwa PBL sebaiknya digunakan dalam pembelajaran karena: (1) Dengan PBL akan terjadi pembelajaran bermakna. Siswa/mahasiswa yang belajar memecahkan suatu masalah maka mereka akan menerapkan pengetahuan yang dimilikinya atau berusaha mengetahui pengetahuan yang diperlukan. Artinya belajar tersebut ada pada konteks aplikasi konsep. Belajar dapat semakin bermakna dan dapat diperluas ketika siswa/mahasiswa berhadapan dengan situasi di mana konsep diterapkan; (2) Dalam situasi PBL, siswa/mahasiswa mengintegrasikan pengetahuan dan ketrampilan secara simultan dan mengaplikasikannya dalam konteks yang relevan. Artinya, apa yang mereka lakukan sesuai dengan keadaan nyata bukan lagi teoritis sehingga masalah-masalah dalam aplikasi suatu konsep atau teori mereka akan temukan sekaligus selama pembelajaran berlangsung; dan (3) PBL dapat meningkatkan kemampuan berpikir kritis, menumbuhkan inisiatif siswa/mahasiswa dalam bekerja, motivasi internal untuk belajar, dan dapat mengembangkan hubungan interpersonal dalam bekerja kelompok.

Gejala umum yang terjadi pada siswa dan mahasiswa pada saat ini adalah “malas berpikir” mereka cenderung menjawab suatu pertanyaan dengan cara mengutip dari buku atau bahan pustaka lain tanpa mengemukakan pendapat atau analisisnya terhadap pendapat tersebut. Bila keadaan ini berlangsung terus maka siswa atau mahasiswa akan mengalami kesulitan mengaplikasikan pengetahuan yang diperolehnya di kelas dengan kehidupan nyata. Dengan kata lain, pelajaran di kelas adalah untuk memperoleh nilai ujian dan nilai ujian tersebut belum tentu relevan dengan tingkat pemahaman mereka. Oleh sebab itu, model PBL mungkin dapat menjadi salah satu solusi untuk mendorong siswa/mahasiswa berpikir dan bekerja ketimbang menghafal dan bercerita.

BAGIMANA MENGIMPLEMENTASIKAN PBL DALAM PEMBELAJARAN ?

Ada beberapa cara menerapkan PBL dalam pembelajaran. Secara umum penerapan model ini mulai dengan adanya masalah yang diharus dipecahkan atau dicari pemecahannya oleh siswa/mahasiswa. Masalah tersebut dapat berasal dari siswa/mahasiswa atau mungkin juga diberikan oleh pengajar. Siswa/mahasiswa akan memusatkan pembelajaran di sekitar masalah tersebut, dengan arti lain, siswa belajar teori dan metode ilmiah agar dapat memecahkan masalah yang menjadi pusat perhatiannya.

Pemecahan masalah dalam PBL harus sesuai dengan langkah-langkah metode ilmiah. Dengan demikian siswa/mahasiswa belajar memecahkan masalah secara sistematis dan terencana. Oleh sebab itu, penggunaan PBL dapat memberikan pengalaman belajar melakukan kerja ilmiah yang sangat baik kepada siswa/mahasiswa. Langkah-langkah pemecahan masalah dalam pembelajaran PBL paling sedikit ada delapan tahapan (*Pannen, 2001*), yaitu:

(1) mengidentifikasi masalah,

(2) mengumpulkan data,

(3) menganalisis data,

(4) memecahkan masalah berdasarkan pada data yang ada dan analisisnya,

(5) memilih cara untuk memecahkan masalah,

(6) merencanakan penerapan pemecahan masalah,

(7) melakukan ujicoba terhadap rencana yang ditetapkan, dan

(8) melakukan tindakan (action) untuk memecahkan masalah.

Empat tahap yang pertama mutlak diperlukan untuk berbagai kategori tingkat berfikir, sedangkan empat tahap berikutnya harus dicapai bila pembelajaran dimaksudkan untuk mencapai keterampilan berfikir tingkat tinggi (*higher order thinking skills*). Dalam proses pemecahan masalah sehari-hari, seluruh tahapan terjadi dan bergulir dengan sendirinya, demikian pula keterampilan seseorang harus mencapai seluruh tahapan tersebut.
Langkah mengidentifikasi masalah merupakan tahapan yang sangat penting dalam PBL. Pemilihan masalah yang tepat agar dapat memberikan pengalaman belajar yang mencirikan kerja ilmiah seringkali menjadi ”masalah” bagi guru dan siswa. Artinya, pemilihan masalah yang kurang luas, kurang relevan dengan konteks materi pembelajaran, atau suatu masalah yang sangat menyeimpang dengan tingkat berpikir siswa dapat menyebabkan tidak tercapainya tujuan pembelajaran. Oleh sebab itu, sangat penting adanya pendampingan oleh guru/dosen pada tahap ini. Walaupun guru/dosen tidak melakukan intervensi terhadap masalah tetapi dapat memfokuskan masalah melalui pertanyaan-pertanyaan agar siswa/mahasiswa melakukan refleksi lebih dalam terhadap masalah yang dipilih. Dalam hal ini guru/dosen harus berperan sebagai fasilitator agar pembelajaran tetap pada bingkai yang direncanakan.
Suatu hal yang sangat penting untuk diperhatikan dalam PBL adalah pertanyaan berbasis why bukan sekedar how. Oleh karena itu, setiap tahap dalam pemecahan masalah, keterampilan mahasiswa dalam tahap tersebut hendaknya tidak semata-mata keterampilan how, tetapi kemampuan menjelaskan permasalahan dan bagaimana permasalahan dapat terjadi. Tahapan dalam proses pemecahan masalah digunakan sebagai kerangka atau panduan dalam proses belajar melalui PBL. Namun yang harus dicapai pada akhir pembelajaran adalah kemampuannya untuk memahami permasalahan dan alasan timbulnya permasalahan tersebut serta kedudukan permasalahan tersebut dalam tatanan sistem yang sangat luas. Apalagi jika PBL digunakan untuk proses pembelajaran di perguruan tinggi.
Lebih lanjut Arends (2004) merinci langkah-langkah pelaksanaan PBL dalam pengajaran. Arends mengemukakan ada 5 fase (tahap) yang perlu dilakukan untuk mengimplementasikan PBL. Fase-fase tersebut merujuk pada tahap-tahapan praktis yang dilakukan dalam kegiatan pembelajaran dengan PBL sebagaimana disajikan pada Tabel 1.

Tabel 1. Sintaks Problem Based Learning
Fase Aktivitas guru

Fase 1:
Mengorientasikan mahasiswa pada masalah Menjelaskan tujuan pembelajaran, logistik yang diperlukan, memotivasi mahasiswa terlibat aktif pada aktivitas pemecahan masalah yang dipilih
Fase 2:
Mengorganisasi mahasiswa untuk belajar Membantu mahasiswa membatasi dan mengorganisasi tugas belajar yang berhubungan dengan masalah yang dihadapi
Fase 3:
Membimbing penyelidikan individu maupun kelompok Mendorong mahasiswa mengumpulkan informasi yang sesuai, melaksanakan eksperimen, dan mencari untuk penjelasan dan pemecahan
Fase 4:
Mengembangkan dan menyajikan hasil karya Membantu mahasiswa merencanakan dan menyi-apkan karya yang sesuai seperti laporan, video, dan model, dan membantu mereka untuk berbagi tugas dengan temannya.
Fase 5:
Menganalisis dan mengevaluasi proses pemecahan masalah Membantu mahasiswa melakukan refleksi terhadap penyelidikan dan proses-proses yang digunakan selama berlangusungnya pemecahan masalah.

Fase 1: Mengorientasikan mahasiswa pada masalah

Pembelajaran dimulai dengan menjelaskan tujuan pembelajaran dan aktivitas-aktivitas yang akan dilakukan. Dalam penggunaan PBL, tahapan ini sangat penting dimana guru/dosen harus menjelaskan dengan rinci apa yang harus dilakukan oleh siswa/mahasiswa dan juga oleh dosen. Disamping proses yang akan berlangsung, sangat penting juga dijelaskan bagaimana guru/dosen akan mengevaluasi proses pembelajaran. Hal ini sangat penting untuk memberikan motivasi agar siswa dapat engage dalam pembelajaran yang akan dilakukan. Sutrisno (2006) menekankan empat hal penting pada proses ini, yaitu: (1) Tujuan utama pengajaran ini tidak untuk mempelajari sejumlah besar informasi baru, tetapi lebih kepada belajar bagaimana menyelidiki masalah-masalah penting dan bagaimana menjadi mahasiswa yang mandiri, (2) Permasalahan dan pertanyaan yang diselidiki tidak mempunyai jawaban mutlak “benar“, sebuah masalah yang rumit atau kompleks mempunyai banyak penyelesaian dan seringkali bertentangan, (3) Selama tahap penyelidikan (dalam pengajaran ini), mahasiswa didorong untuk mengajukan pertanyaan dan mencari informasi. Guru akan bertindak sebagai pembimbing yang siap membantu, namun mahasiswa harus berusaha untuk bekerja mandiri atau dengan temannya, dan (4) Selama tahap analisis dan penjelasan, mahasiswa akan didorong untuk menyatakan ide-idenya secara terbuka dan penuh kebebasan. Tidak ada ide yang akan ditertawakan oleh guru atau teman sekelas. Semua mahasiswa diberi peluang untuk menyumbang kepada penyelidikan dan menyampaikan ide-ide mereka.

Fase 2: Mengorganisasikan mahasiswa untuk belajar

Disamping mengembangkan ketrampilan memecahkan masalah, pembelajaran PBL juga mendorong siswa/mahasiswa belajar berkolaborasi. Pemecahan suatu masalah sangat

membutuhkan kerjasama dan sharing antar anggota. Oleh sebab itu, guru/dosen dapat memulai kegiatan pembelajaran dengan membentuk kelompok-kelompok siswa dimana masing-masing kelompok akan memilih dan memecahkan masalah yang berbeda. Prinsip-prinsip pengelompokan siswa dalam pembelajaran kooperatif dapat digunakan dalam konteks ini seperti: kelompok harus heterogen, pentingnya interaksi antar anggota, komunikasi yang efektif, adanya tutor sebaya, dan sebagainya. Guru/dosen sangat penting memonitor dan mengevaluasi kerja masing-masing kelompok untuk menjaga kinerja dan dinamika kelompok selama pembelajaran.
Setelah mahasiswa diorientasikan pada suatu masalah dan telah membentuk kelompok belajar selanjutnya guru dan mahasiswa menetapkan subtopik-subtopik yang spesifik, tugas-tugas penyelidikan, dan jadwal. Tantangan utama bagi guru pada tahap ini adalah mengupayakan agar semua mahasiswa aktif terlibat dalam sejumlah kegiatan penyelidikan dan hasil-hasil penyelidikan ini dapat menghasilkan penyelesaian terhadap permasalahan tersebut.

Fase 3: Membantu penyelidikan mandiri dan kelompok

Penyelidikan adalah inti dari PBL. Meskipun setiap situasi permasalahan memerlukan teknik penyelidikan yang berbeda, namun pada umumnya tentu melibatkan karakter yang identik, yakni pengumpulan data dan eksperimen, berhipotesis dan penjelasan, dan memberikan pemecahan. Pengumpulan data dan eksperimentasi merupakan aspek yang sangat penting. Pada tahap ini, guru harus mendorong mahasiswa untuk mengumpulkan data dan melaksanakan eksperimen (mental maupun aktual) sampai mereka betul-betul memahami dimensi situasi permasalahan. Tujuannya adalah agar mahasiswa mengumpulkan cukup informasi untuk menciptakan dan membangun ide mereka sendiri. Pada fase ini seharusnya lebih dari sekedar membaca tentang masalah-masalah dalam buku-buku. Guru membantu mahasiswa untuk mengumpulkan informasi sebanyak-banyaknya dari berbagai sumber, dan ia seharusnya mengajukan pertanyaan pada mahasiswa untuk berifikir tentang massalah dan ragam informasi yang dibutuhkan untuk sampai pada pemecahan masalah yang dapat dipertahankan.
Setelah mahasiswa mengumpulkan cukup data dan memberikan permasalahan tentang fenomena yang mereka selidiki, selanjutnya mereka mulai menawarkan penjelasan dalam bentuk hipotesis, penjelesan, dan pemecahan. Selama pengajaran pada fase ini, guru mendorong mahasiswa untuk menyampikan semua ide-idenya dan menerima secara penuh ide tersebut. Guru juga harus mengajukan pertanyaan yang membuat mahasiswa berfikir tentang kelayakan hipotesis dan solusi yang mereka buat serta tentang kualitas informasi yang dikumpulkan. Pertanyaan-pertanyaan berikut kiranya cukup memadai untuk membangkitkan semangat penyelidikan bagi mahasiswa. “Apa yang Anda butuhkan agar Anda yakin bahwa pemecahan dengan cara Anda adalah yang terbaik?” atau “Apa yang dapat Anda lakukan untuk menguji kelayakan pemecahanmu?” atau “Apakah ada solusi lain yang dapat Anda usulkan?”. Oleh karena itu, selama fase ini, guru harus menyediakan bantuan yang dibutuhkan tanpa mengganggu aktivitas mahasiswa dalam kegaitan penyelidikan.

Fase 4: Mengembangkan dan menyajikan artifak (hasil karya) dan mempamerkannya

Tahap penyelidikan diikuti dengan menciptakan artifak (hasil karya) dan pameran. Artifak lebih dari sekedar laporan tertulis, namun bisa suatu videotape (menunjukkan situasi masalah dan pemecahan yang diusulkan), model (perwujudan secara fisik dari situasi masalah dan pemecahannya), program komputer, dan sajian multimedia. Tentunya kecanggihan artifak sangat dipengaruhi tingkat berfikir mahasiswa. Langkah selanjutnya adalah mempamerkan hasil karyanya dan guru berperan sebagai organisator pameran. Akan lebih baik jika dalam pemeran ini melibatkan mahasiswa-mahasiswa lainnya, guru-guru, orangtua, dan lainnya yang dapat menjadi "penilai" atau memberikan umpan balik.

Fase 5: Analisis dan evaluasi proses pemecahan masalah

Fase ini merupakan tahap akhir dalam PBL. Fase ini dimaksudkan untuk membantu mahasiswa menganalisis dan mengevaluasi proses mereka sendiri dan kete-rampilan penyelidikan dan intelektual yang mereka gunakan. Selama fase ini guru meminta mahasiswa untuk merekonstruksi pemikiran dan aktivitas yang telah dilakukan selama proses kegiatan belajarnya. Kapan mereka pertama kali memperoleh pemahaman yang jelas tentang situasi masalah? Kapan mereka yakin dalam pemecahan tertentu? Mengapa mereka dapat menerima penjelasan lebih siap dibanding yang lain? Mengapa mereka menolak beberapa penjelasan? Mengapa mereka mengadopsi pemecahan akhir dari mereka? Apakah mereka berubah pikiran tentang situasi masalah ketika penyelidikan berlangsung? Apa penyebab perubahan itu? Apakah mereka akan melakukan secara berbeda di waktu yang akan datang? Tentunya masih banyak lagi pertanyaan yang dapat diajukan untuk memberikan umpan balik dan menginvestigasi kelemahan dan kekuatan PBL untuk pengajaran.

PBL telah banyak diterapkan dalam pengajaran sains. Gallagher, dkk. (1995) menyatakan bahwa PBL dapat dan perlu termasuk untuk eksperimentasi sebagai suatu alat untuk memecahkan masalah. Mereka menggunakan suatu kerangka kerja yang menekankan bagaimana para mahasiswa merencanakan suatu eksperimen untuk menjawab sederet pertanyaan. Pertanyaan-pertanyaan yang diajukan Gallagher berbasis pada "what do I know", "what do I need to know", "what do I need to learn", dan "how do I measure or describe the result". Selama fase merancang eksperimen berbasis masalah, para mahasiswa mengembangkan suatu protokol yang mendaftar setiap tahap dalam eksperimen itu. Dalam protokol ini, tampak ada kecenderungan yang khas seperti standar perencanaan laboratorium, menjadi suatu tuntunan metakognitif bagi para mahasiswa untuk digunakan dalam pengembangan eksperimen selanjutnya. Penerapan dengan model ini cukup berhasil serta mendukung bahwa PBL dapat mempelopori penggunaan perencanaan laboratorium melalui metode nontradisional.

Model problem based learning telah digunakan oleh para ahli dalam pembelajaran kimia dan turunannya, antara lain pengajaran Biokimia oleh Dods (1996), pembelajaran kimia sintesis bahan alam kompleks oleh Cannon dan Krow (1998), Yu Ying (2003) dalam pengajaran elektrokimia, dan Liu Yu (2004) dalam pengajaran kimia analitik.

Liu Yu (2004, Dosen Jurusan Kimia Univ. Tianjin China) menggunakan PBL dalam pengajaran Kimia Analitik. Menurut Liu Yu, PBL adalah suatu pembelajaran yang didorong atau ditandai oleh adanya masalah, bukan oleh konsep yang abstrak. Idealnya, masalah tersebut dapat ditemukan atau diperoleh dalam kehidupan nyata, dan tidak cepat terselesaikan tetapi dapat diselesaikan dengan mudah. Dalam merancang kegiatan

perkuliahan ini Liu Yu memerlukan waktu 40 jam kuliah dan 32 jam kerja laboratorium. Tujuan perkuliahan adalah: (1) Meningkatkan pengertian lebih mendalam tentang prinsip kimia analitik yang meliputi: sampling, preparasi sampel, separasi, teknik klasik, teknik instrumentasi: spektroskopi, kromatografi, elektrokimia, dan jaminan mutu, (2) Meningkatkan keterampilan teknis kimia analitik dan keterampilan lain pada umumnya, dan (3) Membantu mahasiswa mengembangkan suatu pengertian dan pemahaman yang lebih (mendalam) dan apresiasi terhadap sains.
Prosedur pengembangan PBL yang dilakukan Liu Yu sebagai berikut:

Langkah-langkah/tahapan dalam PBL yang dilalui sbb:

• Problem/Masalah: orientasi permasalahan seperti diuraikan pada bagian berikut.
• Perkuliahan: mahaiswa dibekali prinsip-prinsip dasar metode analitik, dan pengantar menggunakan internet dan perpustakaan untuk menemukan bahan-bahan yang relevan. Tentunya: bagi yang sudah familier dengan internet yang kedua ini tidak terlalu bermanfaat, dan mereka boleh menghindarinya.
• Melacak literatur: berlangsung di luar kelas, mahasiswa menggunakan perpustakaan dan internet untuk memperoleh sumber informasi dalam rangka pemecahan masalah
• Seminar: mahasiswa menyampaikan informasi/gagasan/ide yang telah ditemukan, mendisikusikan masalah dan tukar gagasan.
• Tutorial: apabila mahasiswa mempunyai berbagai pertanyaan, mereka dapat menanyakan kepada dosen selama sesi tutorial ini. Tutor bertindak untuk mengobesrvasi, membimbing, dan mendukung. Setelah mahasiswa menemukan suatu pemecahan, selanjutnya mereka dapat mempersiapkan untuk eksperimen
• Demonstrasi: sebelum mahasiswa melaksanakan eksperimen, dosen dapat mendemonstrasikan (dihadapan mahasiswa) bagaimana mengoperasikan instrumen yang akan digunakan, dan mengenalkan aspek mana yang mendapat perhatian lebih.
• Eksperimen: mahasiswa memperoleh data dari eksperimen, menginterpretasikan hasil, dan menulis laporan. Kegiatan laboratorium menekankan keterampilan teknik dan problem solving.

Dasna (2005) menerapkan model PBL untuk matakuliah Metodologi penelitian Kimia dengan modifikasi langkah-langkah yang dilakukan oleh Liu Yu (2004). Modifikasi dilakukan terkait dengan sifat materi kuliah yang tidak memungkinkan secara langsung mengacu pada masalah nyata. Langkah-langkah pembelajaran dimulai dari ”telaah masalah” untuk memberikan wawasan umum pada mahasiswa tentang apa yang mereka pelajari. Mahasiswa mula-mula diajak berdiskusi untuk membahas suatu karya ilmiah (artikel hasil penelitian) untuk mengidentifikasi ”apa masalah yang dipecahkan pada karya ilmiah tersebut, bagaimana metode pemecahannya, bagaimana hasilnya, relevansinya terhadap teori yang ada, dan pertanyaan yang relevan lainnya. Mahasiswa bekerja berkelompok dan mempresentasikan hasil kerjanya. Kemudian mahasiswa diminta untuk membuat masalah baru dari artikel yang dibacanya.
Untuk menghindari kedangkalan masalah yang dibuat, kemudian diberikan ”kuliah” dimana mahasiswa diberikan bahan kuliah dan pertanyaan-pertanyaan untuk didiskusikan berhubungan dengan materi metode penelitian. Misalnya untuk mengembangkan masalah penelitian diberikan materi ”Apa itu masalah, bagaimana mengembangkan masalah,

bagaimana menuliskan rumusan masalah, dan bagaimana mengembangkan latar belakang masalah. Mahasiswa diminta menelusuri literatur lebih lanjut tentang materi yang diberikan.
Setelah pembahasan teori, mahasiswa kemudian mengembangkan masalah yang akan mereka gunakan sebagai judul skripsi. Mula-mula mahasiswa melakukan studi literatur sesuai dengan minat penelitiannya, memilih dan mendiskripsikan masalahnya, mempresentasikan pada kelompok, masukan dari kelompok, diskusi kelas, masukan dari dosen, dan akhirnya penetapan masalah. Masalah yang ditetapkan sebagai judul proposal penelitian tersebut dilanjutkan dengan langkah-langkah masalah berikutnya yaitu kajian teori, perancangan metode penelitian, prosedur kerja, teknik analisis dan pengumpulan data. Masing-masing tahap dilakukan dengan pengembangan oleh mahasiswa, kuliah, lacak literatur, diskripsi oelh mahasiswa, diskusi kelompok, diskusi kelas, presentasi, masukan oleh dosen, dan revisi produk. Langkah-langkan umum pembelajaran disajikan pada Gambar 2.

Gambar 2. Model PBL yang dikembangkan Dasna (2006) untuk matakuliah dengan materi berurutan

Model yang dikembangkan pada Gambar 2 adalah PBL untuk suatu materi perkuliahan yang mempunyai sequence yang erat. Dalam hal ini, mahasiswa harus mempunyai ”masalah yang akan diteliti dulu” setelah mengkaji hasil penelitian dan kuliah. Penetapan masalah harus dibuat.dipilih oleh mahasiswa kemudian dipresentasikan di kelompoknya (setiap anggota kelompok presentasi), kemudian dipilih satu masalah untuk dipresentasikan di kelas. Dalam hal ini ada masukan dari kelompok lain dan dosen. Setelah itu dilakukan tutorian individual oleh dosen untuk menyempurnakan produk mahasiswa. Mahasiswa melakukan revisi. Kemudian mahasiswa mengerjakan materi pokok pada tahap berikutnya. Mahasiswa diberikan paparan terori melalui kegiatan diskusi, kemudian mereka melakukan kaji literatur, membuat diskripsi sesuai dengan masalahnya sendiri, presentasi dalam kelompok, diskusi kelas, bimbingan dosen, dan revisi. Kemudian mahasiswa mengembangkan materi berikutnya sesuai langkah-langkah tersebut.
Produk akhir dari kuliah ini adalah proposal penelitian yang merupakan gabungan/kompilasi dari tahap-tahap kerja dalam perkuliahan. Produk akhir keseluruhan (berupa proposal penelitian skripsi) dipresentasikan oleh masing-masing mahasiswa pada seminar kelas.

CONTOH IMPLEMENTASI PBL

RENCANA PERKULIAHAN I
MATAKULIAH : Metodologi Penelitian Kimia
MATERI : Pengembangan Masalah penelitian
SEMESTER : Ke 6
PROGRAM STUDI : Kimia
ALOKASI WAKTU : 2 x Pertemuan @ 100 menit

I. Kompetensi

Memahami prinsip-prinsip pengembangan masalah penelitian kimia dan perumusan masalah penelitian

II. Indikator Pencapaian Hasil Belajar

1. menjelaskan perbedaan isu, masalah, dan fakta.
2. Mengidentifikasi masalah dari suatu kasus
3. Mengembangkan masalah dari hasil penelitian
4. Menjelaskan fisibilitas masalah untuk penelitian

III. Kegiatan Pembelajaran

Kegiatan Dosen Waktu

Pendahuluan

1. Menjelaskan tujuan perkuliahan, kegiatan perkuliahan, dan jenis evaluasi yang akan dilakukan
2. Membagi kelompok mahasiswa berdasarkan kriteria yang ditetapkan dosen (1 kelompok 4 orang)
3. Memberikan tugas kepada masing-masing kelompok untuk membahas artikel hasil penelitian kimia yang diberikan oleh dosen

Kegiatan Inti

1. Meminta perwakilan kelompok untuk mendiskripsikan artikel yang dibaca/dibahas meliputi: apa yang diteliti, mengapa orang tersebut melakukan penelitian itu (alasan teoritisnya), bagaimana langkah-langkah yang dilakukan, apa hasilnya, dan bagaimana kesesuaian dengan hasil penelitian lain atau teori yang ada.
2. Setelah semua kelompok selesai, dilakukan diskusi kelas. Dosen memfasilitasi diskusi tentang apa yang disebut masalah, bagaimana membedakan dengan isu, dan fakta, bagaimana teknik mengembangkan masalah penelitian, bagaimana merumuskan masalah, dan fisibilitas penelitian.
3. Menugaskan kepada kelompok untuk mengembangkan masalah baru dari hasil penelitian yang dibaca. Masing-masing kelompok presentasi dan kelompok lain menilai fisibilitas masalah yang dikembangkan.
4. Menugaskan kepada masing-masing mahasiswa mengumpulkan referensi tentang tema penelitian yang akan dipilihnya dan membuat resume masalah yang dipilih.
5. Menugaskan mahasiswa mempresentasikan masalahnya pada kelompok, anggota kelompok menilai fisibilitas dan originalitasnya. Masing-masing kelompok memilih satu masalah yang dipresentasikan di kelas.
6. Presentasi masalah oleh masing-masing kelompok, kelompok lainnya memberikan tanggapan, dan masukan dari dosen.
7. Masing-masing mahasiswa mendiskusikan masalah yang ditulisnya secara personal (bimbingan individual).
8. Mahasiswa mengumpulkan judul dan latar belakang masalah serta rumusan masalah, untuk ditukarkan antar kelompok (diberikan format penilaian).
9. Mahasiswa melakukan revisi produk dan mengumpulkan tugasnya pada dosen.

10. Dosen menugaskan masing-masing mahasiswa untuk melakukan kajian teori/kepustakaan tentang masalah yang dibuat (langkah berikutnya mulai dari langkah 5 sampai 9).

Penutup

1. Dosen memberikan umpan balik pada tugas yang dikumpulkan untuk diperbaiki pada akhir kuliah (proposal).
2. Diberikan umpan balik penilaian kinerja kelompok .
   3 – 4 kali pertemuan

Dalam kegiatan diskusi kelompok, dosen melakukan penilaian kelompok untuk masing-masing mahasiswa, menggunakan rubrik sebagai contoh berikut.

RUBRIK AKTIVITAS DISKUSI

SKOR SKALA KRITERIA

4 = Sangat baik Mahasiswa mengajukan pertanyaan penting berhubungan dengan masalah yang dibahas, frekuensi lebih dari dua kali dalam satu pertemuan, memberikan tanggapan atas pertanyaan temannya, mengambil inisiatif dalam diskusi kelompok

3 = Baik Mahasiswa mengajukan pertanyaan penting berhubungan dengan masalah yang dibahas, frekuensi kurang dari 2 kali, memberikan tanggapan, ada inisiatif walau tidak penting;

2 = Cukup, Mengajukan pertanyaan yang kurang fokus, frekuensi 1 kali, kurang memberikan tanggapan, kurang inisiatif;

1 = Kurang, Pasif dalam diskusi, tidak ada pertanyaan dan tanggapan

PENILAIAN JUDUL, LATAR BELAKANG DAN RUMUSAN MASALAH

Bacalah usulan Judul, latar belakang, dan Rumusan masalah penelitian teman Anda dalam satu kelompok, kemudian berikan penilaian dan saran perbaikan!

JUDUL:……
PENULIS:……

Berikan tanda silang pada skor:
1 bila aspek yang dimaksud sangat kurang 3 baik
2 kurang 4 sangat baik

Aspek SKOR Alasan/
bisa tuliskan dibawah
1 2 3 4
Judul Penelitian
1. Menunjukan variabel yang akan diteliti
2. Menunjukan metode yang digunakan secara jelas
3. Dinyatakan dalam FRASE bukan dalam bentuk kalimat
4. Tidak mengarah pada kesimpulan (Contoh: Makin banyaknya rendeman zat X pada isolasi……)
5. Jelas, informative, tidak bias, menarik
Latar Belakang
1. Mendiskripsikan alasan-alasan dipilihnya masalah penelitian secara jelas
2. Menginformasikan hasil-hasil penelitian sejenis yang telah ada
3. Memberi perbandingan/telaah terhadap hasil-hasil penelitian yang telah ada
4. Mendiskripsikan masalah dan fokus masalah yang akan diteliti
5. Penyajian dari fakta umum, masalah factual, fokus masalah yang diteliti (Paparan secara PIRAMIDA terbalik)
6. Penulisan kalimat mengacu pada bahasa formal ilmiah
7. Tata tulis pengutupan/rujukan benar
Rumusan Masalah
1. Berhubungan dengan masalah
2. Memuat hubungan antar variabel
3. Dapat diukur/diuji dengan metode yang jelas
4. Dalam bentuk kalimat tanya
Catatan lain:
……
……..
Dosen Pembina Penelaah/Reviewer

PENILAIAN KAJIAN TEORI

JUDUL:……
PENULIS:……

Berikan tanda silang pada skor:
1 bila aspek yang dimaksud sangat kurang 3 baik
2 kurang 4 sangat baik

Aspek SKOR Alasan/
bisa tuliskan dibawah
1 2 3 4
Urutan Paparan
1. Pokok-pokok yang dibahas berhubungan dengan variable dan aspek lain penelitian
2. Paparan pada tiap bagian didukung dengan bacaan literatur dan hasil penelitian
2. Pembahasan komprehensif, menyeluruh
3. Penyajian dimulai dari fakta umum, masalah factual, fokus masalah

6. Menjelaskan alasan mengapa variable penelitian dipilih
7. Memberikan alas an pemilihan masalah dan metode pemecahannya
Tata Tulis
1. Cara pengutipan sesuai dengan PPKI
2. Tata kalimat menggunakan bahasa Indonesia formal
3. Frase/paparan mudah dimengerti
4. Penulisan daftar rujukan sesuai PPKI
Daftar Rujukan
1 Daftar rujukan sesuai dengan yang digunakan dalam teks atau masalah
2 Sumber pustakan primer lebih dominan
3 Rujukan dalam bahasa Inggris
4 Rujukan relatif up to date

Catatan lain:
……
……
……

Dosen Pembina Penelaah/Reviewer

…….. ……

Contoh PBL sesuai dengan metode yang dikembangkan oleh Arends (2004) dikembangkan Sutrisno dan Dedek Sukarianingsih untuk Pembelajaran Penentuan Struktur Senyawa Organik di Jurusan Kimia FMIPA UM.

RENCANA PEMBELAJARAN I
MATAKULIAH : Penentuan Struktur Senyawa Organik
MATERI : SPEKTROSKOPI MASSA
SEMESTER : Ke 7
PROGRAM STUDI : Pendidikan Kimia dan Kimia
ALOKASI WAKTU : 10 x Pertemuan @ 100 menit

I. Kompetensi
Memahami prinsip dasar spektroskopi massa dan mampu menginterpretasikan spektrum massa
II. Indikator Pencapaian Hasil Belajar
5. memahami prinsip dasar spektroskopi massa
6. menjelaskan metode produksi ion
7. menjelaskan corak utama puncak-puncak khas dalam spektrum massa
8. menginterpretasikan spektrum massa untuk menduga atau menurunkan struktur senyawa organik dan sebaliknya
9. menjelaskan pola umum aturan fragmenatsi dalam spektra massa
III. Kegiatan Pembelajaran

Kegiatan Dosen Kegiatan Mahasiswa Waktu
Pendahuluan
11. Meminta pada mahasiswa untuk mengungkap kembali "pemahamannya" (dari ikatan kimia, Kimia Organik I, II, III dan Kimia Organik Fisik): sifat ikatan senyawa organik, penamaan, isomerik, dan lain-lain yang dimiliki mahasiswa
12. Merekam (memperhatikan dan menulis ungkapan yang dikemukakan mahaiswa di papan tulis), memberikan sedikit ulasan.
13. Menyampaikan tujuan pembelajaran tentang Spektroskopi Massa: prinsip dasar, interpretasi spektra, dan manfaatnya untuk menetapkan struktur (informasi diberikan secara garis besar, melalui transparansi atau hand-out). Sumber bahan ajar lain berupa buku ajar.
14. Mengungkapkan kembali pengetahuan yang telah dimiliki tentang gugus fungsi karbonil, seperti diharapkan oleh dosen
15. Diharapkan ada diskusi antar teman yang duduk bersebelahan
16. Menerima informasi

3 – 4 kali pertemuan
INTI
Fase 1: Mengorientasikan mahasiswa pada masalah
• Meminta mahasiswa untuk menghayati dan merenungkan kembali apa-apa yang yang telah disampaikan pada tahap pendahuluan.
• Meminta kepada mahasiswa untuk memperhatikan suatu kasus sebagai berikut:
"……"
• Dengan memperhatikan kasus tersebut mahasiswa diharapkan dapat menyusun masalah dan memecahkannya, serta mengembangkannya. Permasalahan diarahkan pada metode produksi ion, fragmentasi, dan interpretasi spektra massa
• Pemecahan masalah diselasaikan melalui forum diskusi kelompok (kecil dan kelas) pada fase selanjutnya.

Fase 2 : Mengorganisir mahasiswa untuk belajar
• Meminta mahasiswa untuk membagi diri dalam beberapa kelompok (penentuan kelompok ditetapkan oleh dosen berdasarkan IP semester sebelumnya). Tiap kelompok terdiri 4–5 orang.
• Membagikan bahan bacaan tambahan kepada mahasiswa untuk bahan diskusi
• Meminta mahasiswa mencermati bahan bacaan (yang dibagikan, hasil informasi, dan dari buku/modul ajar yang ada).

Fase 3 : Membantu mahasiswa memecahkan masalah

Pada fase ini dosen berkeliling dan terkadang masuk ke dalam kelompok secara bergiliran dengan:
• Meminta mahasiswa memahami isi wacana dalam bahan bacaan, hand-out, buku ajar, dan lainnya.
• Memotivasi/mendorong mahasiswa untuk diskusi dalam kelompoknya tentang apa-apa yang diharapkan.
• Meminta mahasiswa untuk menuliskan hasil pekerjaanya pada catatan kuliah (untuk

masing-masing mahasiswa) dan pada plastik transparansi (untuk masing-masing kelompok: satu kelompok cukup satu perwakilan) yang telah disediakan dengan kreatifitas masing-masing.
• Memantau jalannya diskusi
• Meminta kepada masing-masing kelompok untuk mengumpulkan hasil-hasil diskusinya yang telah dituliskan untuk digunakan sebagai bahan pada fase berikutnya

Fase 4 : Mengembangkan dan menyajikan hasil pemecahan masalah

• Meminta perwakilan kelompok untuk menyajikan/mempresentasikan hasil-hasil diskusi (karyanya) di depan kelas
• Meminta mahasiswa untuk memperhatikan sajian/paparan hasil karya dari kelompok yang mempresentasikan, mencermati, dan membandingkan dengan hasil dari kelompoknya sendiri.
• Membimbing mahasiswa untuk mempresentasikan hasil diskusinya.
• Membimbing mahasiswa untuk melakukan diskusi kelas
• Mencatat hal-hal yang menyimpang atau tumpang tindih atau "unik" antara kelompok yang satu dengan yang lain.
• Menilai keaktifan siswa (individu dan kelompok) dalam kelas saat presentasi berlangsung
Fase 5 : Menganalisis dan mengevaluasi proses pemecahan masalah
• Dosen membantu mahasiswa mengkaji ulang proses/hasil pemecahan masalah
• Dosen memberikan penjelasan mengenai hal yang tumpang tindih atau "unik" dan mengulas hal yang baru dan berbeda pada tiap kelompok.
• Merekam jalannya pembelajaran

• Mencermati arahan dan penjelasan dosen
• Mengikuti perkembangan proses pembelajaran

• Membentuk kelompok
• Menerima bahan bacaan untuk diskusi
• Menindaklanjuti arahan dosen

• Menanyakan hal-hal yang kurang dipahami.
• Diskusi kelompok.
• Menuliskan hasil diskusi

• Mempresentasi hasil diskusi
• Tiap kelompok memperoleh kesempatan yang sama dalam presentasi
• Melakukan diskusi kelas / tanya jawab

• Mencermati penjelasan dosen
• Bertanya tentang hal yang kurang dipahami

1 – 2 kali pertemuan

1 – 2 kali pertemuan

1 – 2 kali pertemuan

2 kali pertemuan
Penutup
• Dosen bersama mahasiswa menyimpulkan apa yang telah dipelajari secara bersama tentang golongan senyawa turunan asam karboksilat
• Merencanakan ujian bagian.
• Mengikuti langgam dosen dalam pembelajaran ½ kali pertemuan

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& Komentar »

1. 

agus_irsyad Berkata:

on Nopember 18, 2007 at 12:29 am

saya sangat senang dengan artikel ini dan bisa juga buat bahan tuk tugas-tugas saya. thanks.

2.

soetarno bin said smadajoe Berkata:

on Nopember 24, 2007 at 9:34 am

artkel menarik, bisa dikembangkan untuk pembelajaran kimia dan PTK untuk guru

3.

trulli arviansyah Berkata:

on Januari 1, 2008 at 4:51 pm

mohon bantuan kisi - kisi penyusunan skripsi dengan menggunakan metode PBL pada jurusan matematika.
saya masih bingung dan belum dapat pegangan untuk skripsi semester depan. karena saya ingin mengangkat judul skripsi dengan metode tersebut.
terima kasih atas bantuan yang diberikan.
semoga bapak - bapak tidak keberatan atas permohonan bantuan saya ini.
terima kasih

4.

susanto,s.... Berkata:

on Februari 12, 2008 at 1:22 pm

saya senang mendapat petunjuk secara teoritis dalam penyusunan PTK yang menggunakan strategi PBM

5.

rbaryans Berkata:

on Maret 5, 2008 at 10:48 am

mohon ijin untuk di copy mas….nuwun…

6.

LUKMAN Berkata:

on Maret 10, 2008 at 9:25 am

artikel ini sangat bagus dapat menambah wawasan tentang model pembelajaran. Saya tunggu kabar selanjutnya.

7. 

yustiandi Berkata:

on Mei 9, 2008 at 2:00 pm

saya merasa terbantu dengan adanya artikel ini…PBM dapat dikatakan sebagai model dan juga dapat dikatakan sebagai pendekatan, yang jadi pertanyaan saya, kapan PBM dikatakan sebagai model dan kapan PBM dikatakan sebagai pendekatan?terima kasih….

8. 

July Berkata:

on Mei 23, 2008 at 3:38 am

tulisan ini baik sekali dan sangat membantu saya. PBL selayaknya harus sudah diterapkan di yunior atau high school. tapi bagaimana jika PBL mulai diterapkan di primary school ? tentunya dengan level yang berbeda…karena jika dari SD siswa sudah di latih berpikir kritis akan sangat baik dalam perkembangan pendidikannya. Bagaimana pendapat bpk ? atau mungkin bpk memiliki kerangka PBL yang sesuai ? saya tunggu kabar selanjutnya. Trimah kasih.

9.

radha Berkata:

on Mei 26, 2008 at 3:07 am

Thx bngat y..udh bantu, xeesaikan tgas q…. alx q perlu banget artikel ttg PBL nie……

10.

yusuf Berkata:

on Juni 18, 2008 at 7:18 am

sangat menarik. tolong tambahi buat fisika ya mas. because I'm mhswa pend. fisika. wassalam.

II

What is Problem-Based Learning?*

Problem-based learning (PBL), at its most fundamental level, is an instructional method characterized by the use of "real world" problems as a context for students to learn critical thinking and problem solving skills, and acquire knowledge of the essential concepts of the course. Using PBL, students acquire life long learning skills which include the ability to find and use appropriate learning resources. The process used in PBL is the following:

Belajar Berbasis Masalah (PBL), pada tingkatan yang paling pokok, adalah suatu metoda pembelajaran yang ditandai dengan penggunaan permasalahan "dunia nyata" sebagai konteks untuk para siswa daalam belajar berfikir kritis dan keterampilan memecahkan masalah, serta memperoleh pengetahuan konsep yang penting tentunya. Menggunakan PBL, para siswa memperoleh keterampilan belajar sepanjang hayat yang meliputi kemampuan untuk menemukan dan menggunakan kesesuaian sumber-sumber belajar. Proses menggunakan PBL adalah yang berikut:

1. Students are presented with a problem (case, research paper, video tape, for example). Students (in groups) organize their ideas and previous knowledge related to the problem, and attempt to define the broad nature of the problem. Para siswa disajikan suatu masalah (contohnya; kasus, catatan/hasi penelitian, tape video,. Para siswa (dalam kelompok) mengorganisir gagasan mereka dan pengetahuan sebelumnya berhubungan dengan masalah, dan mencoba untuk mendefinisikan alam secara luas tentang suatu permasalahan.
2. Throughout discussion, students pose questions, called "learning issues," on aspects of the problem that they do not understand. These learning issues are recorded by the group. Students are continually encouraged to define what they know - and more importantly - what they don't know.
3. Students rank, in order of importance, the learning issues generated in the session. They decide which questions will be followed up by the whole group, and which issues can be assigned to individuals, who later teach the rest of the grouop. Students and instructor also discuss what resources will be needed in order to research the learning issues, and where they could be found.
4. When students reconvene, they explore the previous learning issues, integrating their new knowledge into the context of the problem. Students are also encouraged to summarize their knowledge and connect new concepts to old ones. They continue to define new learning issues as they progress through the problem.

Students soon see that learning is an ongoing process, and that there will always be (even for the teacher) learning issues to be explored.

.

2. Sepanjang;Seluruh diskusi, para siswa bersikap pertanyaan, [disebut/dipanggil] " belajar isu," pada [atas] aspek masalah yang mereka tidak memahami. Ini isu pelajaran direkam oleh kelompok [itu]. Para siswa secara terus menerus didukung untuk menggambarkan apa [yang] mereka mengetahui- dan lebih penting lagi- apa [yang] mereka tidak mengetahui.
3. Para siswa tergolong, disusun menurut arti penting, isu pelajaran menghasilkan sesi [itu]. Mereka memutuskan pertanyaan yang akan [jadi] diikuti atas oleh keseluruhan kelompok, dan isu yang (mana) dapat ditugaskan ke individu, [siapa] yang kemudiannya mengajar sisa dari grouop [itu]. Para siswa Dan Instruktur juga mendiskusikan sumber daya apa [yang] akan [jadi] diperlukan dalam rangka riset belajar isu, dan [di mana/jika] mereka bisa ditemukan.

4. Kapan para siswa berkumpul kembali, mereka menyelidiki yang sebelumnya belajar isu, pengintegrasian [yang] pengetahuan [yang] baru mereka ke dalam konteks masalah [itu]. Para siswa adalah juga didukung untuk meringkas pengetahuan mereka dan menghubungkan konsep baru ke yang lama. Mereka melanjut untuk menggambarkan baru belajar isu [sebagai/ketika] mereka maju melalui/sampai masalah [itu]. Para siswa segera lihat bahwa pelajaran adalah suatu proses berkelanjutan, dan bahwa akan selalu ada (bahkan untuk guru) belajar isu untuk diselidiki.

What is the faculty role in PBL? The instructor must guide, probe and support students' initiatives, not lecture, direct or provide easy solutions. The degree to which a PBL course is student-directed versus teacher-directed is a decision that the faculty member must make based on the size of the class, the intellectual maturity level of the students, and the instructional goals of the course. When faculty incorporate PBL in their courses, they empower their students to take a responsible role in their learning - and as a result, faculty must be ready to yield some of their own authority in the classroom to their students. Apa yang merupakan peran fakultas/pancaindera di (dalam) PBL? Instruktur harus memandu, memeriksa dan mendukung prakarsa siswa, [yang] tidak memberi kuliah, mengarahkan atau menyediakan solusi gampang. Derajat tingkat [bagi/kepada] YANG (MANA) SUATU PBL kursus adalah student-directed (me)lawan teacher-directed adalah suatu keputusan [bahwa/yang] fakultas/pancaindera anggota harus membuat berdasar pada ukuran kelas, kedewasaan yang intelektual tingkat para siswa, dan gol intervi kursus [itu]. Kapan fakultas/pancaindera menyertakan PBL di (dalam) kursus mereka, mereka menguasakan para siswa mereka untuk mengambil suatu peran bertanggung jawab di (dalam) pelajaran mereka- dan sebagai hasilnya, fakultas/pancaindera harus siap;kan untuk menghasilkan sebagian dari otoritas mereka sendiri di (dalam) kelas kepada para siswa mereka.

Resource articles

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PROBLEM-BASED LEARNING

A Note From the Issue Editor -- Barbara J. Duch

"How can I get my students to think?" is a question asked by many faculty, regardless of their disciplines. They say that their students seem to lack the ability or motivation to go beyond factual knowledge to a deeper understanding of the course material. Indeed, they seem to have difficulty connecting basic principles and concepts to their related essential applications. Problem-based learning (PBL) is an instructional method that challenges students to "learn to learn," working cooperatively in groups to seek solutions to real world problems. These problems are used to engage students' curiosity and initiate learning the subject matter. PBL prepares students to think critically and analytically, and to find and use appropriate learning resources. " Bagaimana mungkin aku mendapat/kan para siswa ku untuk berpikir?" adalah suatu pertanyaan yang [diminta;tanya] oleh banyak fakultas/pancaindera, dengan mengabaikan disiplin mereka. Mereka kata[kan bahwa para siswa mereka nampak untuk kekurangan motivasi atau kemampuan [itu] untuk pergi di luar pengetahuan berdasar fakta [bagi/kepada] suatu pemahaman [yang] lebih dalam material kursus. Tentu saja, mereka nampak untuk mempunyai kesukaran [yang] menghubungkan konsep dan prinsip basis dasar kepada aplikasi penting terkait mereka. Pelajaran Problem-based (PBL) adalah suatu metoda intervi yang menghadapi tantangan para siswa untuk " belajar untuk belajar," aktip dengan cara kerja sama di (dalam) kelompok untuk mencari solusi ke permasalahan dunia nyata. Permasalahan ini digunakan untuk melibatkan pelajaran permulaan dan kecurigaan siswa pokok materi perihal. PBL siap[kan para siswa untuk berpikir dengan kritis dan secara analitis, dan untuk temukan dan menggunakan sesuai belajar sumber daya

Since the summer of 1992, over one hundred and fifty faculty and administrators have attended one or more PBL workshops sponsored by CTE. Many of those teachers are now using these student-centered learning methods in their classes. In January, 1995, we published our first About Teaching issue devoted to PBL. That issue defined PBL and had several articles written by faculty who have used problem-based techniques in their courses. If you are interested in another copy of that issue, please contact CTE (X2027) or you may access those articles on the UD PBL Webpage (http://www.udel.edu/pbl/). [Karena;Sejak] musim panas 1992, (di) atas seratus lima puluh fakultas/pancaindera dan pengurus sudah menghadiri satu atau lebih PBL tempat kerja yang disponsori oleh CTE. Banyak dari para guru itu kini menggunakan [yang] student-centered ini belajar metoda di (dalam) kelas mereka. Pada bulan Januari, 1995, kita menerbitkan [yang] pertama [kita/kami] Tentang Isu Pengajaran mempersembahkan kepada PBL. Isu itu menggambarkan PBL dan mempunyai beberapa artikel yang [di]tertulis oleh fakultas/pancaindera [siapa] yang sudah menggunakan teknik problem-based di (dalam) kursus mereka. Jika kamu adalah tertarik akan yang lain salinan yang mengeluarkan, menyenangkan kontak CTE (X2027) atau kamu boleh mengakses artikel itu pada [atas] UD PBL Webpage (Http://Www.Udel.Edu/Pbl/).

This issue highlights large enrollment courses that have adapted PBL (Al Thompson, Geology and Linda Dion, Biology), courses using peer tutors (Deborah Allen, Biology, Sherry Kitto, Plant and Soil Sciences, and Lesa Griffiths, Animal and Food Sciences), an Art History class (Mark P. Miller) and a comparative study of PBL vs. lecture format (Elizabeth Lieux, Nutrition and Dietetics). Students (Jennifer Johnson, Amy Robinson, Todd Rudo, and Trish Westenbroek) who have taken a PBL course and also served as

peer tutors describe their experiences in the two roles. The questions, "What makes a good PBL problem?" and "How can I write my own?" are addressed and examples of problems in biology and physics are highlighted. Isu ini menyoroti kursus pendaftaran besar yang sudah beradaptasi PBL (Al Thompson, Geologi Dan Linda Dion, Biologi), Guru privat Panutan Penggunaan Kursus (Deborah Allen, Biologi, Minuman anggur manis Kitto, [Pabrik/Tumbuhan] dan Ilmu pengetahuan Lahan, dan Lesa Griffiths, Binatang Dan Ilmu pengetahuan Makanan), suatu Kelas Sejarah Seni (Tanda P. Tukang giling) dan suatu studi perbandingan PBL melawan memberi kuliah format (Elizabeth Lieux, Ilmu gizi dan Mengenai pantangan makan). Para siswa (Jennifer Johnson, Amy Robinson, Todd Rudo, dan Trish Westenbroek) [siapa] yang sudah mengambil suatu PBL kursus dan juga guru privat panutan yang bertindak sebagai menguraikan pengalaman mereka di (dalam) peran keduanya. Pertanyaan, " Apa yang buatan suatu PBL masalah baik?" dan " Bagaimana mungkin aku tulis ku sendiri?" ditujukan dan contoh permasalahan di (dalam) biologi dan ilmu fisika digarisbawahi.

If you are new to PBL and want to find out more about it -- consider coming to the Fifth Annual Conference at Clayton Hall on June 9-12. Details are in this issue. Jika kamu adalah baru ke PBL dan ingin menemukan lebih banyak tentang itu-- mempertimbangkan memasuki Konferensi [yang] Tahunan Yang ke lima pada Clayton Hall/Aula pada [atas] Juni 9-12. Detil dalam terbitan ini.

III

IV

"CREATING PROBLEMS" FOR PBL

Hal White
Dept. of Chemistry and Biochemistry

Problems. Problems! Everybody's got problems. Yet when faculty consider introducing problem-based learning into their courses, one of the perceived "problems" is a lack of suitable problems. Adoption of the problem-based approach to learning can profoundly change one's notion of a good problem. End-of-the-chapter textbook problems suddenly seem inappropriate -- often contrived, narrowly focused, and vaguely irrelevant. A good problem typically involves a real situation, sequential components, and sufficient complexity to engage a group of students productively for up to a week or more. Case studies in business and medicine have these qualities. They require students to gain understanding, apply multiple concepts, and make decisions based on their work. Outside of business and medicine, where does an instructor find problems to use?

Permasalahan. Permasalahan! Permasalahan semua orang diperoleh. Namun ketika fakultas/pancaindera mempertimbangkan memperkenalkan pelajaran problem-based ke dalam kursus mereka, salah satu [dari] yang dirasa " permasalahan" adalah suatu ketiadaan permasalahan pantas. Adopsi pendekatan yang problem-based [bagi/kepada] belajar kaleng [yang] sangat ber;ubah dugaan seseorang suatu masalah baik. End-Of-The-Chapter permasalahan buku teks [yang] tiba-tiba nampak tidak sesuai-- sering mengusahakan, sedikit dipusatkan, dan samar-samar tidak relevan. Suatu masalah baik [yang] secara khas melibatkan suatu situasi riil, komponen percontohan, dan kompleksitas cukup untuk melibatkan seorang kelompok para siswa [yang] secara produktif untuk [yang] atas [bagi/kepada] suatu minggu atau lebih []. Studi kasus di (dalam) bisnis dan [obat/ kedokteran] mempunyai kualitas ini. Mereka

memerlukan para siswa untuk memperoleh pemahaman, [menerapkan/berlaku] berbagai konsep, dan keputusan buatan berdasar pada pekerjaan mereka. Di luar bisnis dan [obat/ kedokteran], di mana suatu instruktur temukan permasalahan untuk menggunakan?

Unfortunately, published collections of problems do not exist for many subjects. Consequently, instructors usually write their own problems and case studies if they want to use problem-based instruction. While creating problems obviously takes time and may deter some instructors from adopting problem-based instruction, once started, the activity can be enormously stimulating. It becomes an intellectual challenge to write problems that pique students' curiosity, require analysis, and generally encourage learning. How students learn becomes as important as what they learn. One must reconsider what students really need to learn and the environment in which they learn. Much of the enthusiasm for the problem-based approach to learning comes from instructors who feel revitalized by the creative energy it releases. Sungguh sial, koleksi permasalahan yang diterbitkan tidak ada untuk banyak pokok. [Yang] sebagai konsekwensi, instruktur [yang] pada umumnya tulis studi kasus dan permasalahan mereka sendiri jika mereka ingin menggunakan instruksi problem-based. [Selagi/Sedang] menciptakan permasalahan [yang] sungguh-sungguh memerlukan banyak waktu dan boleh menghalangi instruktur beberapa dari mengadopsi instruksi problem-based, sekali ketika memulai, aktivitas dapat dengan sangat merangsang. [Itu] menjadi suatu tantangan intelektual untuk tulis permasalahan yang mengesalkan kecurigaan siswa, memerlukan analisa, dan biasanya mendorong pelajaran. Bagaimana para siswa belajar menjadi sepenting seperti apa [yang] mereka belajar. Sese]Orang harus reconsider para siswa apa [yang] benar-benar harus belajar dan lingkungan di mana mereka belajar. Sebagian besar gairah untuk pendekatan yang problem-based [bagi/kepada] belajar datang dari instruktur [siapa] yang merasakan revitalized oleh energi yang kreatif [itu] melepaskan.

Upon reflection, most instructors have little trouble identifying suitable topics on which to base problems. Problems can come from classic works that define the intellectual growth of a discipline. They can come from present and past controversies, clever application of important concepts to every-day situations, current events, or personal experience. The sources are almost unlimited. I rely heavily on the research literature in my disciplines as a source of problems. My approach was strongly influenced by a little book, "A Strategy for Education," written by Herman Epstein and published by Oxford University Press in 1970. [Atas/Ketika] cerminan/pemantulan, kebanyakan instruktur hanya mempunyai sedikit gangguan [yang] mengidentifikasi topik pantas yang di atasnya untuk mendasarkan permasalahan. Permasalahan dapat datang dari pekerjaan klasik yang menggambarkan pertumbuhan yang intelektual suatu disiplin. Mereka dapat datang dari [kini/hadir] dan kontroversi yang lampau, aplikasi [yang] pandai [dari;ttg] konsep penting untuk tiap hari situasi, peristiwa sekarang, atau pengalaman pribadi. Sumber hampir tak terbatas. Aku mempercayakan dengan berat pada [atas] literatur riset di (dalam) disiplin ku sebagai sumber permasalahan. Pendekatan ku betul-betul dipengaruhi oleh suatu buku [kecil/sedikit], " Suatu Strategi untuk Pendidikan," yang [di]tertulis oleh Herman Epstein dan yang diterbitkan oleh Universitas Sepatu tumit rendah Tekan 1970.

In the sciences, undergraduates rarely have to read the periodical scientific literature. Rather, they read colorfully illustrated, encyclopedic textbooks which are wonderful resources but reveal little about the development of current concepts and the process of science as a human activity. Epstein, sensitive to these issues and dissatisfied with teaching a watered-down biology major's course to non-science majors, taught

introductory biology at Brandeis University without a textbook. Instead, he selected a chronological series of related research articles for his students to read. This "graduate seminar for freshmen" focused on the scientist, rather than the science. The articles were important documents revealing the scientists who wrote them, and the students learned a lot of biology. They also learned that science was more than a collection of facts; it was a rational way of finding out about the world that anyone could use. Di (dalam) ilmu pengetahuan, mahasiswa belum bergelar [yang] jarang harus membaca literatur ilmiah yang secara berkala. Melainkan, mereka membaca secara berwarna-warni/bersemangat menggambarkan, yang buku teks seperti ensiklopedi adalah sumber daya sangat bagus tetapi mengungkapkan [kecil/sedikit] tentang pengembangan [dari;ttg] konsep sekarang dan proses ilmu pengetahuan sebagai aktivitas manusia. Epstein, sensitip ke isu ini dan tidak puas dengan pengajaran suatu biologi yang diecerkan kursus utama ke jurusan tidak ilmu pengetahuan, mengajar biologi pengantar pada Brandeis Universitas tanpa suatu buku teks. Sebagai ganti(nya), ia memilih suatu rangkaian [yang] menurut urutan waktu [dari;ttg] artikel riset terkait untuk para siswa nya untuk membaca. Ini " lulus seminar untuk freshmen" yang dipusatkan pada [atas] ilmuwan, dibanding/bukannya ilmu pengetahuan [itu]. Artikel adalah dokumen penting yang menyatakan ilmuwan [itu] [siapa] yang menulis [mereka/nya], dan para siswa mempelajari banyak biologi. Mereka juga mempelajari ilmu pengetahuan itu lebih dari suatu koleksi fakta; [itu] adalah suatu [jalan/cara] [yang] masuk akal mengenali tentang dunia yang seseorang bisa menggunakan.

One might think that science majors would appreciate the process of science and the motivation of scientists already but, in my experience, that is not the case. Consequently, in 1988 when the undergraduate biochemistry major was established, CHEM 342 Introduction to Biochemistry was among the required courses in the sophomore year. That course was based on Epstein's model but has continued to evolve with the increasing number of biochemistry majors. Without changing the content, CHEM 342 was transformed into a problem-based course two years ago. The articles became the problems and the lecture-discussion format was replaced by groups of four or five students working on the "problems" during class time. The biochemistry majors learn about the disciplines by reading, discussing, and ultimately understanding publications by research biochemists. Satu kekuatan berpikir ilmu pengetahuan itu jurusan akan menghargai proses ilmu pengetahuan dan motivasi ilmuwan telah tetapi, di (dalam) pengalaman ku, bukan ini masalahnya. Sebagai konsekwensi, di (dalam) 1988 ketika biokimia mahasiswa belum bergelar yang utama telah dibentuk/mapan, CHEM 342 Pengenalan ke Biokimia adalah di antara kursus yang diperlukan di (dalam) tahun mahasiswa tingkat dua. Kursus itu telah didasarkan pada Model Epstein's tetapi mempunyai tetap meningkatkan dengan sejumlah jurusan biokimia yang terus meningkat . Tanpa mengubah isi [itu], CHEM 342 telah diubah ke dalam suatu kursus problem-based dua tahun yang lalu. Artikel menjadi permasalahan [itu] dan lecture-discussion format telah digantikan oleh kelompok empat atau lima para siswa yang bekerja pada [atas] " permasalahan" selama waktu kelas. Jurusan Biokimia belajar tentang disiplin dengan pembacaan, mendiskusikan, dan akhirnya penerbitan pemahaman [oleh/dengan] ahli biokimia riset.

Although almost any biochemical theme could be used in a course like CHEM 342, I use a series of about ten articles which trace the history of our understanding of hemoglobin and its involvement in sickle cell anemia over the past century. The selections include classic articles by prominent scientists about discoveries whose significance extends well beyond the theme of the course. A one to two page, referenced introduction, and an overview accompanies each article. It provides information about the authors, sets the context in which the work was done, and connects the article with others used in the

course. In addition to an introductory overview, each article comes with a succession of assignments culminating with one through which students can demonstrate their understanding of the article. Walaupun hampir manapun tema biokimia bisa digunakan [adalah] suatu kursus seperti CHEM 342, aku menggunakan satu rangkaian sekitar sepuluh yang artikel melacak sejarah [dari;ttg] pemahaman hemoglobin [kita/kami] dan keterlibatan nya di (dalam) sel arit anemia (di) atas masa lalu abad. Pemilihan meliputi artikel klasik oleh ilmuwan terkemuka tentang penemuan arti siapa meluas baik di luar tema kursus [itu]. Yang [bagi/kepada] dua halaman, pengenalan yang disesuaikan, dan suatu ikhtisar menemani artikel masing-masing. [Itu] menyediakan informasi tentang pengarang, menetapkan konteks [itu] di mana pekerjaan telah dilaksanakan, dan menghubungkan artikel [itu] dengan (orang) yang lain menggunakan kursus [itu]. Sebagai tambahan terhadap suatu ikhtisar pengantar, masing-masing artikel datang dengan suatu rangkaian tugas yang memuncak dengan satu dengan mana para siswa dapat mempertunjukkan pemahaman mereka artikel [itu].

Invariably students do not understand an article when they first read it. Initially they must define learning issues -- words, concepts, procedures, etc., that they will need to learn about before they can understand the article. Defining one's ignorance is a most important first step in problem-based learning. During the first day of group discussion, students share their learning issues and attempt to resolve them. Those that remain at the end of class become group learning issues that are ranked in order of their perceived importance and assigned to group members to look up before the next class. After several iterations of this process, students demonstrate their understanding by completing a specific assignment such as: Write a 200-word abstract of the article. Conceptualize the article's conclusions with a diagram and legend suitable for a textbook or make up a problem for an introductory chemistry course based on the article. At other times they are asked to decide whether a researcher displayed racial prejudice in an article or whether a particular human experiment was ethically justified. Midterm and final examinations include individual and group parts modeled on the above activities. Tanpa alternatip para siswa tidak memahami suatu artikel ketika mereka pertama membaca itu. Pada awalnya mereka harus menggambarkan belajar isu-- kata-kata, konsep, prosedur, dll., bahwa mereka akan harus belajar sekitar [sebelum/di depan] mereka dapat memahami artikel [itu]. Penjelasan ketidak-tahuan seseorang adalah suatu [yang] pertama paling utama masuk pelajaran problem-based. Sepanjang hari diskusi kelompok yang pertama, para siswa berbagi mereka belajar isu dan mencoba untuk memecahkan [mereka/nya]. . yang tinggal pada ujung kelas menjadi kelompok yang belajar isu yang diatur disusun menurut arti penting [yang] dirasa mereka dan menugaskan ke anggota kelompok untuk memandang [sebelum/di depan] kelas yang berikutnya [itu]. Setelah beberapa perkataan berulang-ulang [dari;ttg] proses ini, para siswa mempertunjukkan pemahaman mereka dengan perlengkapan suatu tugas spesifik seperti: Tulis suatu 200-word abstrak artikel [itu]. Conceptualize kesimpulan artikel dengan suatu diagram dan legenda yang pantas untuk suatu buku teks atau menyusun;merias suatu masalah untuk suatu kursus ilmu kimia [yang] pengantar berdasar pada artikel [itu]. Pada lain [kali;zaman] [yang] mereka diminta untuk memutuskan apakah suatu peneliti mempertunjukkan prasangka rasial di (dalam) suatu artikel atau apakah eksperimen manusia tertentu secara etis dibenarkan. Midterm Dan Ujian akhir meliputi individu dan [part;bagian] kelompok memperagakan pada [atas] [itu] di atas aktivitas.

A major individual assignment (problem) in CHEM 342 asks each student to select and study the lives and accomplishments of two prominent biochemists, identify some nontrivial theme that relates to both, and develop the theme in a term paper using the biographies. Students are encouraged with extra credit to interview their subjects after they have familiarized themselves with several significant articles by the biochemists.

Suatu tugas individu utama (masalah) di (dalam) CHEM 342 [minta;tanya] siswa masing-masing untuk memilih dan belajar pemenuhan dan hidup [itu] dua ahli biokimia terkemuka, mengidentifikasi beberapa nontrivial tema yang berhubungan dengan kedua-duanya, dan kembang;kan tema [itu] di (dalam) suatu catatan/kertas istilah yang menggunakan riwayat hidup [itu]. Para siswa didukung dengan kredit ekstra untuk mewawancarai pokok mereka setelah mereka sudah membiasakan diri diri mereka dengan beberapa artikel penting oleh ahli biokimia [itu].

Having taught CHEM 342 twice in a problem-based format, I have become even more aware of how rich the research literature is as a source of problems and how effectively the problem-based approach matches my idealized concept of the roles of students and teachers. As a result, I read the research literature with a notebook at my side where I can write rough drafts of problems for all the courses I teach. Next year my students in another course will learn about the chemical properties of DNA in a literature-based problem I call "Jurassic Park Revisited." Setelah mengajar CHEM 342 dua kali di (dalam) suatu format problem-based, aku sudah menjadi lebih lagi sadar akan bagaimana kaya literatur riset adalah sebagai sumber permasalahan dan bagaimana secara efektif pendekatan yang problem-based [tanding/ temu] konsep [yang] diidealkan ku peran para siswa dan para guru. Sebagai hasilnya, aku membaca literatur riset [itu] dengan suatu buku catatan pada sisi ku [di mana/jika] aku dapat tulis rancangan permasalahan untuk semua kursus [yang] aku mengajar. Tahun depan para siswa ku di (dalam) kursus lain akan belajar tentang sifat kimia DNA di (dalam) suatu masalah literature-based [yang] aku [sebut/panggil/hubungi] " Taman Jurassic Unjungi kembali."

VI

PBL and the Lively Classroom

Kurt Burch
Political Science & International Relations

Problem-based learning (PBL) is both a familiar teaching approach and a dramatic innovation that transforms the classroom experience for students and teachers. Working in groups, students confront a tangible problem -- medical diagnosis, legal dispute, policy proposal, ethical dilemma -- to resolve. Since the students lack significant information and experience, they ask questions. The stock query "why do we need to know this?" is suddenly replaced by the question "what do we need to know?" Through these questions, called "learning issues", students become responsible for their own learning; they tap into their creative resources; and they develop direction and focus. In this setting teachers become mentors and facilitators. They move among groups, directing students' discussions and energies when appropriate. Rather than lecture information or manage behavior, teachers cultivate skills, focus effort, foster resourcefulness, and maintain an interactive climate of learning. Pelajaran Problem-based (PBL) adalah kedua-duanya suatu umum dikenal mengajar pendekatan dan suatu inovasi dramatis yang mengubah bentuk pengalaman kelas [itu] untuk para siswa dan para guru. Kelompok Aktip, Para siswa menghadapi suatu masalah terukur-- hasil diagnosa medis, perselisihan sah/tentang undang-undang, proposal kebijakan, dilema etis-- untuk memecahkan. [Karena;Sejak] para siswa kekurangan informasi penting dan pengalaman, mereka [minta;tanya] pertanyaan. Bursa/Stock query " kenapa kita harus mengetahui ini?" tiba-tiba digantikan oleh pertanyaan " apa yang kita harus mengetahui?" Melalui pertanyaan ini , [disebut/dipanggil] "

belajar isu", para siswa menjadi [yang] bertanggung jawab untuk pelajaran mereka sendiri; mereka menyadap ke dalam sumber daya kreatif mereka; dan mereka kembang;kan arah dan memusatkan. Di (dalam) ini para guru pengaturan menjadi penasihat dan facilitators. Mereka pindah;gerakkan antar kelompok, pengarahan energi dan diskusi siswa ketika sesuai. Dibanding/Bukannya memberi kuliah informasi atau mengatur perilaku, para guru menanami ketrampilan, memusatkan usaha, membantu perkembangan kepanjangan daya akal, dan memelihara suatu iklim interaktip terpelajar.

PBL revolves around a focal problem, group work, feedback, class discussion, skill development, and final reporting. The teacher organizes and pilots this cycle of activity, then teaches skills within that context. Inviting students into a learning experience that allows them to reckon it in their own terms, this technique provides the opportunity for active learning. Also, PBL provides the opportunity to integrate diverse elements, such as case studies (the problem), group work (student teams), problem-solving (vocational learning-by-doing), Socratic method (teacher interaction with groups), and class discussion. PBL berputar-balik di sekitar suatu masalah focal, kerja kelompok, umpan balik, diskusi kelas, pengembangan ketrampilan, dan pelaporan akhir. Guru mengorganisir dan mengemudikan siklus aktivitas ini, kemudian mengajar ketrampilan di dalam konteks itu. Undang para siswa ke dalam suatu belajar pengalaman yang mengijinkan [mereka/nya] untuk memperhitungkan ia/nya di (dalam) terminologi mereka sendiri, teknik ini menyediakan kesempatan [itu] untuk pelajaran aktip. Juga, PBL menyediakan kesempatan [itu] untuk mengintegrasikan unsur-unsur berbeda, seperti studi kasus (masalah), kerja kelompok (regu siswa), pemecahan masalah ([yang] learning-by-doing kejuruan), Metoda Socratic (Interaksi Guru dengan kelompok), dan diskusi kelas.

The mechanics of a PBL course are varied, as seen in the accompanying articles in this issue of About Teaching. These techniques are especially effective for courses in the natural sciences where the "solutions" to puzzles are more specific, but the routes are many. Law courses are similar. I teach International Relations, (IR) however, where solutions are indeterminant. Advancing and contesting proposed solutions is the political "stuff" of IR. In this light I modified liberally and eclectically the PBL framework for a Spring 1994 course entitled Contemporary Problems in World Politics. According to course ratings and end-of-semester comments, students enjoyed and valued both the course and the experience. So did I. Mekanika suatu PBL kursus bervariasi, [seperti/ketika] dilihat di artikel yang menemani dalam terbitan ini Tentang Pengajaran. Teknik ini [yang] efektif untuk kursus di (dalam) ilmu pengetahuan alam [di mana/jika] " solusi" ke teka-teki jadilah lebih spesifik, tetapi rute adalah banyak orang. Kursus Hukum adalah serupa. Aku mengajar Hubungan Internasional, (IR) bagaimanapun, [di mana/jika] solusi adalah indeterminant. Mempercepat dan kontes solusi diusulkan adalah yang politis " bahan" tentang IR. Di (dalam) [cahaya/ ringan] ini [yang] aku memodifikasi dengan bebas dan eclectically PBL kerangka untuk suatu [Musim semi/ mata air] 1994 kursus berjudul Permasalahan Jaman ini di (dalam) Politik Dunia. Nurut kursus [yang] menilai dan end-of-semester komentar, para siswa menikmati dan menghargai kedua-duanya kursus dan pengalaman [itu]. Demikian juga aku.

Rather than formal case studies, I used films and brief novels to illustrate the contemporary problems of war and violence, human rights, poverty and prosperity, and cultural clash. In each source the main character was a young adult confronting a difficult choice in a difficult situation. The weekly theme was "what would you do?". We drew conclusions about how such choices could lead to (or represent) global problems. Dibanding/Bukannya studi kasus formal, aku menggunakan film dan meringkas roman untuk menggambarkan permasalahan [kekerasan/ kehebatan] dan peperangan yang jaman ini, hak

azasi manusia, kemiskinan dan kemakmuran, dan persilisihan budaya. Pada setiap sumber karakter yang utama adalah suatu orang dewasa muda [yang] menghadapi suatu pilihan sulit di (dalam) suatu situasi sulit. Tema yang mingguan adalah " apa [yang] akan kamu lakukan?". Kita [menggambar/menarik] kesimpulan tentang bagaimana . seperti (itu) aneka pilihan bisa mendorong kearah (atau menghadirkan) permasalahan global.

On Mondays, the class briefly discussed the works, noting key characters, problems, and relationships. We tried to connect the specific themes of the assigned work to larger global themes. Then students would break into their groups and I'd identify a specific or similar problem for them to discuss on Wednesday. For example, in Dawn, Elisha must decide whether to execute the captured British officer and in A Man for All Seasons, Sir Thomas More must decide whether to compromise his principles or resist King Henry's wishes. I had them debate with each other, then vote. Intriguingly, more would have compromised their principles than not, but fully half would have executed the British officer. With this result, I divided the class into self-styled "executioners" and "compassionates." Each was to prepare a debate: to kill or not to kill? Come Friday, I reversed their roles. I had the spokesperson for the "executioners" argue the "compassionates" point of view, and vice-versa. The point was to illustrate how we can become prisoners of our own view of the world. If we can't appreciate the point of view of others, then we are reduced to violence, hence oppression and rebellion. Pada hari Senen, kelas [yang] dengan singkat membahas pekerjaan [itu], mencatat karakter kunci, permasalahan, dan hubungan. Kita mencoba untuk menghubungkan tema yang spesifik pekerjaan yang ditugaskan ke tema global lebih besar. Kemudian para siswa akan menerobos kelompok mereka dan Aku akan mengidentifikasi suatu masalah [yang] serupa atau spesifik untuk [mereka/nya] untuk mendiskusikan pada [atas] Rabu. Sebagai contoh, di (dalam) Dinihari, Elisha harus memutuskan apakah untuk melaksanakan Petugas Britania yang ditangkap dan di (dalam) Seorang Laki-Laki untuk Semua Musim, Tuan Thomas Lebih harus memutuskan apakah untuk berkompromi prinsip nya atau Raja lapisan pelindung Berbagai keinginan henry. Aku mempunyai [mereka/nya] berdebat satu sama lain, kemudian memilih. Secara membangkitkan minat, lebih [] pasti telah bersepakat prinsip mereka daripada tidak, tetapi secara penuh separuh pasti telah mengeksekusi Petugas yang Britania [itu]. Dengan hasil ini , aku membagi kelas [itu] ke dalam self-styled " algojo" dan " berbelas kasih." Masing-Masing adalah untuk siap[kan suatu debat: untuk membunuh atau bukan untuk membunuh? Jumat Yang datang, aku membalikkan peran mereka. Aku mempunyai spokesperson untuk " algojo" membantah " yang berbelas kasih" segi pandangan, dan sebaliknya. Titik adalah untuk menggambarkan bagaimana kita dapat menjadi narapidana [dari;ttg] pandangan kita sendiri dunia. Jika kita tidak bisa menghargai segi pandangan dari yang lain, kemudian kita dikurangi menjadi [kekerasan/ kehebatan], karenanya tekanan dan pemberontakan.

It is the same with PBL. By decentralizing the classroom, students discover the latitude to explore ideas and express themselves. They also find they must engage others and confront ideas novel to them. Not every student will appreciate or take advantage of the opportunities, but they will fare no less well than in a conventionally organized course. Indeed, in such proximity to energized students, they will observe the excitement of active learning. Those who become engaged will shine because they can radiate their creativity. Rather than perform on tailored assignments, such students can decide how to proceed and express themselves. These are essential skills for success in life. Why not emphasize them in the classroom? [Itu] adalah sama dengan PBL. Dengan mendesentralisasi kelas [itu], para siswa menemukan garis lintang [itu] untuk menyelidiki gagasan dan menyatakan diri mereka. Mereka juga temukan mereka harus melibatkan (orang) yang lain dan menghadapi roman gagasan kepada [mereka/nya]. Bukan tiap-tiap siswa akan menghargai atau mengambil

keuntungan dari peluang, tetapi mereka akan tidak membiayai apapun lebih sedikit sumur dibanding [adalah] suatu kursus [yang] di/terorganisir. Tentu saja, dalam . yang sedemikian dekatnya untuk memberi tenaga para siswa, mereka akan mengamati kegembiraan [dari;ttg] pelajaran aktip. Mereka yang menjadi ditautkan akan bersinar sebab mereka dapat menyebar kreativitas mereka. Dibanding/Bukannya melaksanakan pada [atas] tugas dikhususkan, . seperti (itu) para siswa dapat memutuskan bagaimana cara berproses dan menyatakan diri mereka. Ini adalah ketrampilan penting untuk sukses dalam hidup. Mengapa tidak menekankan [mereka/nya] di (dalam) kelas?

As educators, we can easily convey information. We then become mobile, vocal encyclopedia. Yet is when we develop skills and foster learning, we become effective teachers. Many students think that "knowledge" means "information." As faculty, we realize that true knowledge implies understanding. Therefore, we need to provide opportunities for our students to foster understanding. PBL provides such opportunities. It may be adapted for myriad subjects, grade levels, or course structures. It can be used throughout a course or as a model for a single unit. Both teachers and students will be pleasantly startled by the results. It worked so well with 22 students that I'm currently using it for a graduate seminar and plan to employ it in an Intro section of 125 students. [Sebagai/Ketika/Sebab] pendidik, kita dapat dengan mudah menyampaikan informasi. Kita kemudian menjadi encyclopedia berkenaan dengan suara gesit. Namun adalah ketika kita kembang;kan ketrampilan dan membantu perkembangan pelajaran, kita menjadi para guru efektif. Banyak para siswa berpikir bahwa " pengetahuan" [alat/ makna] " informasi." [Sebagai/Ketika/Sebab] fakultas/pancaindera, kita menyadari bahwa pengetahuan benar menyiratkan pemahaman. Oleh karena itu, kita harus menyediakan peluang untuk para siswa [kita/kami] untuk membantu perkembangan pemahaman. PBL menyediakan kesempatan semacam itu. Mungkin saja sesuai pokok banyak sekali, menyusun/menilai tingkatan, atau struktur kursus. [Itu] dapat digunakan sepanjang;seluruh suatu kursus atau sebagai suatu model untuk unit tunggal. Kedua-Duanya para guru dan para siswa akan [jadi] senang terkejut oleh hasil [itu]. [Itu] bekerja/lancar sangat baik dengan 22 para siswa bahwa Aku sekarang ini menggunakan ia/nya untuk suatu seminar lulusan dan merencanakan untuk mempekerjakan ia/nya di (dalam) suatu Intro Bagian 125 para siswa.

VII

Introducing Art History Through Problem-Based Learning

Mark Parker Miller,
Art History

You have been hired as consultants for a major motion picture. Although the story, set in ancient Greece (c. 425 B.C.), is fictional, the director wants every detail in the film to be as historically accurate as possible. Part of the action will take place around a temple. Your task is to determine what this temple should look like -- including the interior, the exterior, the immediate vicinity, and the activities in and around the temple. If possible, recommend a location (or locations) where the filming of the temple scenes could take place. Include notes about what, if any, aspects of the setting would need to be altered -- either physically or through special effects -- in order to be accurate.

This was one of eight problems that confronted students enrolled in the course Myth, Religion, and Art (ARTH 151) during fall semester at the Wilmington campus (Division

of Continuing Education). The focus of the course was the many ways that spiritual beliefs generate and shape works of art. Examples that we considered came from a variety of cultures from antiquity to the present, and from various places around the world. There are no prerequisites for this course and usually the students are not art history majors. For most of the students in the class this is their introduction to the discipline (and perhaps the only art history course they will ever take).

Students in the course developed solutions for the assigned problems by working together in small groups. Each group had five members (except for one group that included an auditor as its sixth member). The course met once a week in the evening for three hours at a time. Each week, during the last third of the class period, students received a new problem. Because many of the students were unable to meet with their group outside of class time, I allocated a significant portion of each class meeting for group work. Members of the group worked on aspects of the problem individually over the following week and then reconvened at the beginning of the next class meeting to synthesize their findings. While the students worked in their groups, I circulated among them, monitored their progress and participated in their discussions to assist them toward a solution. A week later, at the next class meeting, each group submitted a brief written report summarizing their response to the problem. During the middle portion of each class, I introduced new topics by presenting a lecture with slides, showing a video, or leading a discussion of assigned readings.

My primary objectives in assigning the problem "Greek Temples: the Movie" were for the students to: 1) deepen their awareness and understanding of a specific form of religious architecture (ancient Greek temples) and of its role within the religious practices of its culture; 2) find and use appropriate resources for this task; and 3) develop critical-thinking skills through the process of solving a complex problem. Judging from the reports that the groups submitted, the students achieved most of what I had asked of them. They fell short in the area of how an ancient Greek temple functioned within the religious practices of its culture -- *i.e.*, primarily to house and protect the cult statue while the actual worship takes place at an outdoor altar. However, this component was probably the hardest part of the assignment, requiring information that is lacking from many sources (or, at least, found only through careful reading). What more than made up for an oversight like this and what impressed me most about using a problem-based approach for this course was the high level of active participation of the students in the learning process. It was exciting to see nearly every student arrive each week with a stack of books they had found or with pages of notes related to the problem.

Student evaluations of the course were also positive. In the beginning a few students had difficulty with the format -- most students in the class had no previous experience with PBL -- but by midterm all had adjusted well. Part of my rationale for using problem-based learning is that people remember best by translating concepts into their own words and by doing (rather than just reading, hearing or seeing). Comments from the students confirm the value of this approach:

- *I enjoyed . . . the weekly problems. Sharing ideas with other group members really helped give a well-rounded insight into all subject areas.*
- *I had fun in this class while still learning and I think that is the most important aspect.*
- *I learned more with the group than I would have individually.*
- *I knew nothing of art & the history behind the sculpture[s], pictures, cathedrals, mosques, etc., so all of it was new. And I know that what I've learned & experienced in this class will stay with me for the rest of my life.*

What more could a teacher hope for?

VIII

A Comparative Study of Learning in Lecture *vs.* Problem-Based Format

Elizabeth M. Lieux,
Nutrition and Dietetics

The course that I have taught for 14 years, Quantity Food Production and Service, is required for most students in Nutrition and Dietetics and for all Hotel, Restaurant, and Institutional Management majors. The classes were getting larger, from about 20 students to over 80, and becoming much less fun to teach. I found that although my teaching evaluations were acceptable, they were not at the level of my other courses nor the level I had come to expect in this course. Although I tried to keep the lectures fresh with new stories, readings, videos, projects, and lecture notes, it was clear that student interest (as well as my own) was flagging.

After attending several workshops I thought that problem-based learning (PBL) might be a method to revitalize the course and me. I had concerns that many faculty have expressed about changing to PBL. I was unsure if we could "cover" as much material with the new method. I had always been satisfied with the quantity of important information I was able to provide to each class through lectures. Many dietetics students had commented that the information gained in this course had enabled them to perform extremely well on a nationally administered examination to become a Registered Dietitian. Would PBL allow dietetics students to continue to exceed the national mean in foodservice management?

I also gave some thought to teaching evaluations. I consider teaching to be the most important thing that I do and it was hard to imagine how not lecturing would continue to allow me to feel like a good teacher. Would students view my contribution to their learning as useful and valuable or would my teaching evaluations go down?

With these and other concerns in mind I decided to teach the course using the two methods of instruction and compare as many parameters as possible to determine whether lecture and PBL were equal in outcome. In the Fall of 1994 I offered two sections of Quantity Food Production and Service. Both were taught at 8:00 A.M. and both used the

same learning objectives, textbook, and readings. The lecture section had 75 minute lectures interspersed with some videos, a small amount of group work, and one case. The PBL section had 10 problems which students worked on in groups for two class sessions each.

Research on Lecture Method *vs.* Problem-Based Learning Method

Research methods to compare process and outcomes included a pretest of knowledge about food and nutrition, a pretest and posttest of preferred learning environment, attendance records, qualitative assessment of classroom environment, student evaluations of the course using the Instructional Development and Effectiveness Assessment instrument (IDEA), and a common essay-type final exam composed of eight questions (students chose five to answer).

Independent and dependent t-tests plus Chi Square tests were conducted on the data to determine significant differences between the two methods of instruction. Stepwise regression of four independent variables (grade point average (GPA), section, major, gender) were significant predictors of dependent variables (learning environment pretest and posttest, knowledge pretest, and final exam).

Quantitative Results of the Study

The results of comparing the two instructional methods suggest there is no real difference in learning achieved between lecture and PBL methods nor does method of teaching change the preferred learning environment. Caution in interpreting regression analyses is warranted because of the small numbers of students available to be included in each model.

Twenty percent of the variance in knowledge of food and nutrition at the beginning of the course was explained by GPA, not section, major, or gender. This indicated that students in both sections were not different initially in their knowledge of the prerequisite information.

Eleven percent of the variance in the preferred learning environment was explained by section, not GPA, major, or gender for the pretest. Seven percent of the variance was explained by section for the posttest. Neither section changed their preferred learning environment as a result of taking the course.

Twenty nine percent of the variance in performance on the final exam was explained by the GPA and major, not section or gender. Students with higher GPAs and those majoring in Hotel, Restaurant and Institutional Management performed better in the final exam.

Therefore I conclude that learning important concepts in Quantity Food Production and Service is achieved equally using either the lecture method or PBL.

Attendance was significantly higher in the PBL class than in the lecture class. PBL students attended an average of 23.5 and lecture students 17.5 of 26 sessions. The

implication of this data is that I had more opportunities to interact with students because they were more likely to attend PBL classes than lecture classes.

Course Evaluations

Whenever there are major changes within a course it is important for the instructor to get as much feedback from students about their perceptions of the effectiveness of the course as is possible. This was done using observations from an outside reviewer and through both informal and formal student evaluations. The results of student evaluations were not analyzed statistically but there are some interesting observations to be made which reinforced qualitative information provided by the reviewer and students. Students in the lecture class (58% completed the instrument) perceived they learned more than the PBL class (97% completed the instrument). All four parameters which comprise subject matter mastery in the IDEA instrument were above the 82nd percentile for the lecture class with two above the 92nd percentile. PBL students perceived that they learned less; two parameters measured were < 60th percentiles. This perception is not supported by the results of the final exam which show equal learning with both methods. I believe that there was discussion outside of class between students in both sections comparing what they were learning. PBL students identified that they were covering less material than lecture students so they assumed they were "learning" less.

PBL students perceived they developed thinking and problem solving skills (91st percentile) as compared with lecture students (71st percentile). Additionally PBL students perceived development of effective communication skills (89th percentile) and sense of personal responsibility (90th percentile), results which were not perceived by students in the lecture method. This outcome is most gratifying because thinking, problem solving, and communication skills are essential in the graduates of both programs.

Both sections of students provided approximately the same rating for course description parameters although PBL students perceived they worked somewhat harder than lecture method students. The rating as to whether they would like the instructor again was exactly the same (3.7 on a scale of 1-5).

The main area of guidance derived from the student evaluations that caused me concern related to my communication of content and purpose. Students in the lecture method were much more satisfied with my demonstration of the significance of the subject, summarization methods, communication of course objectives, and explanations than were students in the PBL section. This reinforced subjective comments by the PBL students that they wished they had more lecture.

Results of Evaluations

Since this first offering of the course I have developed several tactics to provide more support and structure for the PBL students. Now, I briefly introduce each problem, provide more direction as they are working through the problems, and do a wrap-up of the important points they should have addressed in each problem. This has given the

majority of students who have a preferred learning environment that tends to be more teacher-centered than student-centered the confidence to explore unknown areas.

Student evaluations were initially very useful to help identify an area where I could provide much needed help. Now the evaluations are confirming that good teaching is not only lecturing but providing an environment and interesting materials to allow the student to explore, learn, and grow in teams. My teaching evaluations continue to improve and I'm having much more fun with this course because I can see the students working through the problems and developing group process, research, and communication skills. Most are more interested and active learners than students in the lecture method, and the classroom is a lively place to be.

IX

PBLN @ IMSA Overview

Problem-based learning (PBL) is an educational approach that organizes curriculum and instruction around carefully crafted ill-structured" problems. Students gather and apply knowledge from multiple disciplines in their quest for solutions. Guided by teachers acting as cognitive coaches, they develop critical thinking, problem solving, and collaborative skills as they identify problems, formulate hypotheses, conduct data searches, perform experiments, formulate solutions and determine the best "fit of solutions to the conditions of the problem. Problem-based learning enables students to embrace complexity, find relevance and joy in their learning, and enhance their capacity for creative and responsible real-world problem-solving.

The internationally recognized Illinois Mathematics and Science Academy® (IMSA) develops creative, ethical leaders in science, technology, engineering and mathematics. As a teaching and learning laboratory created by the State of Illinois, IMSA enrolls academically talented Illinois students (grades 10-12) in its advanced, residential college preparatory program. It also serves thousands of educators and students in Illinois and beyond through innovative instructional programs that foster imagination and inquiry. (www.imsa.edu)

To advance IMSA's mission, the Academy established PBLN @ IMSA in 1992.

PBLN @ IMSA engages in PBL professional development, research, information exchange, curriculum development and networking in K-16 educational settings.

The goals of PBLN @ IMSA are:

- *To mentor* educators in all disciplines as they design and develop effective problem-based learning (PBL) materials and become skillful coaches in K-16 classrooms and other educational settings.

- *To explore* problem-based learning (PBL) strategies as the context in which knowledge is acquired, ethical decision-making is nurtured, and problem-solving skills are developed with learners of all abilities.
- *To connect* problem-based learning (PBL) educators through numerous networking options designed to meet a variety of needs.

To Mentor

PBL is most meaningfully learned through intensive professional development programs that include elements of discussion, demonstration, and immersion for teachers and administrators interested in transforming teaching and learning. For this reason,PBLN @ IMSA:

- presents at state and national conferences throughout Illinois and across the country.
- convenes the Neison and Bette Harris Institute for Problem-Based Learning annually to provide an introductory experience that features demonstrations, active problem design opportunities, and practice with coaching strategies and authentic assessment.
- offers mutually supportive professional development partnerships with schools committed to problem-solving and higher order thinking across the curriculum.
- customizes advanced programs for experienced problem-based educators which focus on fine tuning classroom problems, microteaching opportunities for refining coaching skills, and exploring critical thinking techniques to enhance the teacher's problem-solving tool kit.

I'm a straight A student, but it's mostly because I know how to find answers in the textbooks. I've never had to defend my own answers--I think this is the first time I've ever had to think! Cool...
Student
Summer Sleuths
IBPLN

To Explore

PBL and its effects on students' acquisition of knowledge, development of decision-making processes, and refinement of problem-solving skills within and across disciplines are of prime interest. To advance PBL research,PBLN @ IMSA:

- raises critical questions about PBL.
- studies the nature of PBL itself.
- examines the outcomes of PBL--both from the perspective of teacher and student.
- reports its findings to the educational community.
- encourages informed research by teachers.
- collaborates with other institutions in broad-based research initiatives.

To Connect

PBLN @ IMSA encourages teachers to share ideas, test new strategies, and refine them. This requires a sense of connection and community. Numerous networking options have been designed to build an active, world-wide network of PBL practitioners. To this end,PBLN @ IMSA:

- promotes interactive dialogue around PBL issues that encourages creativity, provides support for innovation and resources for development, and builds learning communities.
- moderates an Internet listserve linking PBL partners and enabling dialogue about critical issues and concerns.
- designs and maintains an interactive World Wide Web site to provide another source of support for educators developing PBL materials.
- facilitates ASCD's (Association for Supervision and Curriculum Development) PBL Net, a member network.
- publishes *The Problem Log* newsletter.
- coordinates the Illinois Problem-Based Learning Network for the Illinois State Board of Education.
- develops and supports Teacher Associates and Fellows able to assist PBLN @ IMSA in its activities.
- arranges PBL classroom observation opportunities.
- encourages PBL educators to submit their exemplary materials to expand the work of PBL.

Some Closing Thoughts

We had one set of kids making recommendations about district policy to two school board members and a superintendent and a principal. And they walked away from that saying, 'We could say something. We had something to say and adults listened to us.'
Teacher
PBL Partnership

Following the 1992 Wingspread Conference on Problem-Based Learning in which nationally prominent educators met to explore the nature and potential of the approach, one curriculum specialist said, Problem-based learning is a strong paradigm...through which many topics and skills can be learned ... [W]onderful things can happen.

Problem-based learning programs in school systems throughout the country are demonstrating that when students and teachers are actively engaged in real-world problems, teaching and learning are transformed, and wonderful things will indeed happen. We invite you to join us in this promising and exciting venture.

The initiative of PBLN @ IMSA has been showcased in numerous publications including, *Educational Leadership, Teacher Magazine, Leadership News, The Executive Educator, IASCD Update,* and the *Journal for the Education of the Gifted.*

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History

IMSA established PBLN @ IMSA to engage in PBL research, information exchange, teacher training and curriculum development in K-16 educational settings. This work is supported through the generosity of the The Harris Family Foundation and The Hitachi Foundation.

Neison Harris of The Harris Family Foundation gave the Illinois Mathematics and Science Academy (IMSA) a challenge grant to createPBLN @ IMSA. Harris said he is happy to have provided venture capital for the PBLN @ IMSA: I am captivated by this highly promising teaching strategy, and am particularly pleased to support such a visionary institution committed to serving not only its own students, but also educators and students throughout the state and the nation.

Recognizing the power and potential of problem-based learning and the central role of PBLN @ IMSA in connecting and mentoring individuals interested in PBL, The Hitachi Foundation has provided financial support for the creation and continuation of a nationwide network of PBL practitioners. This grant supports a broad vision of networking that includes:

- Person to person connections at conferences and institutes,
- An internet listserv to facilitate day to day dialogue among practitioners,
- A multidimensional PBL webpage
- PBL NET start-up and continuation support,
- Publishing support for The Problem Log, and
- Hosting the PBL Forum at the ASCD Annual Conference.

Contact Us

PBLN @ IMSA is always looking for enthusiastic individuals who are interested in working with and learning about PBL. If you are interested in finding out more about PBL, or would like to become more deeply involved, please contact PBLN @ IMSA and consider taking part in one of our many programs. We are glad you visited our web site, and hope you found it to be useful and informative. Please fill out a feedback form if you have comments or questions about our site. Thank you!

- General Information
- Illinois Problem-Based Learning Network
- Neison and Bette Harris Institute for Problem-Based Learning

- ASCD's Problem-Based Learning Network
- PBLN @ IMSA K-16 Dialogue List
- PBLN @ IMSA web site feedback

General Information

If you would like to know more about PBLN @ IMSA or PBL in general, contact:

PBLN @ IMSA
Illinois Mathematics and Science Academy
1500 W. Sullivan Road
Aurora, IL 60506
(630) 907-5957/6
pbl-info@imsa.edu

Illinois Problem-Based Learning Network

The Illinois Problem-Based Learning Network (IPBLN) is sponsored by the PBLN @ IMSA and supported by the Illinois State Board of Education through their Center for Scientific Literacy. IMSA and ISBE have convened a select group of Illinois educators from across the state and the disciplines who are committed to the advancement of the habits of mind which contribute to scientific literacy through classroom applications of problem-based learning.

This program highlights the strengths of the PBL and scientific literacy connection; nurtures an ever expanding network of Illinois educators knowledgeable in PBL; and offers opportunities for future involvement in - or leadership of - other state-wide efforts.

If you would like to learn more about the Illinois Problem-Based Learning Network, please visit IPBLN's web site or contact:

Debra Gerdes
Professional Development and Research Coordinator, PBLN @ IMSA
Illinois Mathematics and Science Academy
1500 W. Sullivan Road
Aurora, IL 60506
(630) 907-5957/6
dgerdes@imsa.edu

Neison and Bette Harris Institute for Problem-Based Learning

The goal of the Institute is to provide educators hands-on experience as PBL learners and designers. Participants receive instruction and mentoring in designing PBL curriculum

and developing implementation strategies from experienced PBL educators while engaging in guided practice and dialogue with fellow participants. If you would like to learn more about the Neison and Bette Harris Institute for Problem-Based Learning, please visit this informational web page or contact:

PBLN @ IMSA
Illinois Mathematics and Science Academy
1500 W. Sullivan Road
Aurora, IL 60506
(630) 907-5957/6

ASCD's Problem-Based Learning Network

ASCD's PBL NET is a network of educators from varied contexts and levels of education united by a common interest in problem-based learning. PBL Net values PBL as a natural organizing center for curriculum coupled with an instructional strategy.

If you would like to learn more about the Problem-Based Learning Network, please visit PBLN's web site or contact:

PBLN @ IMSA
Illinois Mathematics and Science Academy
1500 W. Sullivan Road
Aurora, IL 60506
(630) 907-5957/6
pbl-info@imsa.edu

PBLN @ IMSA K-16 Dialogue List

PBLN @ IMSA K-16 Dialogue List is for educators and anyone interested in PBL at the K-16 levels, for any discipline area. PBL is a curriculum development and instructional system which simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem-solvers confronted with an ill-structured problem that mirrors real-world problems. If you would like to learn more about thePBLN @ IMSA K-16 Dialogue List, please visit this informational web page or contact:

PBLN @ IMSA
Illinois Mathematics and Science Academy
1500 W. Sullivan Road
Aurora, IL 60506
(630) 907-5957/6
pbl-info@imsa.edu

Web Site Feedback Form

Many hours were spent designing and redesigning the PBLN @ IMSA web site to best serve you. If you have any comments or suggestions about the content or design of this site, we would love to hear from you via our web feedback form.

XI

What is PBL ?

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What is PBL?

Problem-based learning (PBL) is a curriculum development and instructional approach.

What does PBL do?

PBL simultaneously develops problem solving strategies, disciplinary knowledge bases, and skills.

How does PBL do it?

By placing students in the active role of problem-solvers confronted with an ill-structured problem which mirrors real-world problems.

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Problem-based learning has as its organizing center the ill-structured problem that ...

- is messy and complex in nature
- requires inquiry, information-gathering, and reflection
- is changing and tentative
- has no simple, fixed, formulaic, right solution

Examples of ill-structured problems used in PBL

You are:

- a scientist at the state department of nuclear safety. Some people in a small community feel their health is at risk because a company keeps thorium piled above ground at one of their plants. What action, if any, should be taken?

  Summer Challenge 1992, IMSA

- a consultant to the Department of Fish and Wildlife. A first draft of a plan for the reintroduction of wolves to Yellowstone has received strong, negative testimony at hearings. What is your advice regarding the plan?

  John Thompson, Ecology, IMSA

- a science advisor at NASA. A planet much like the earth has experienced massive destruction of elements of its biosphere. What is causing the destruction of plant life? Can new plants from earth be successfully introduced to help save the planet's environment?

  Bill Orton, 2nd grade, Williamsburg, VA

- a thirty-six year old single working mother with a five year old daughter. Upon your husband's death, you receive $20,000 in worker's compensation and $10,000 in stock option shares. How can you invest this money so that by your daughter's 18th birthday, its growth is maximized?

  LuAnn Malik, Community College of Aurora, Aurora, CO

- a member of President Truman's Interim Committee. What advice will you give the President to help end the war in the Pacific? An atomic bomb has just been detonated at Los Alamos.

  Bill Stepien, American Studies, IMSA

- invited to participate in a special session of your school board to determine whether Huckleberry Finn should be taught in your school district given its inclusion on a state censorship list.

  Ed Plum, American Literature, District #214, Barrington, IL

- a stockholder of a major oil refinery in Louisiana which has mined oil from wetlands in the southern part of the state. You have received pressure from publicity about the wetlands to make it property of the federal government so that it can be protected. What will you do?

  Christine Vitale, 4-5 multi-grade, Arlington Heights, IL

- the principal of Foggeybottom High School asked by the school board to present a new comprehensive blue-print for all teachers to use at the school. What will your plan look like? What rationale will you give for the plan?

  Diana Weidenbacker, Winnacunnet Alternative School, Winnacunnet, NY

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Next >How does PBL compare with other instructional approaches?

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Considerations:

- role of the problem
- role of the teacher
- role of the learner

Problem-based learning **begins** with the introduction of an ill-structured problem on which all learning **centers**. Teachers assume the role of cognitive and metacognitive coach rather than knowledge-holder and disseminator; students assume the role of active problem-solvers, decision-makers, and meaning-makers rather than passive listeners.

Problem-Based Learning causes a shift in roles...

Teacher as coach

Models/coaches/fades in:

- Asking about thinking
- Monitoring learning
- Probing/challenging students' thinking
- Keeping students involved
- Monitoring/adjusting levels of challenge
- Managing group dynamics
- Keeping process moving

Student as active problem-solver

- Active participant
- Engaged
- Constructing meaning

Problem as initial challenge and motivation

- Ill-structured
- Appeals to human desire for resolution/stasis/harmony
- Sets up need for and context of learning which follows

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What are the benefits of PBL?

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Motivation

PBL makes students more engaged in learning because they are hard wired to respond to dissonance and because they feel they are empowered to have an impact on the outcome of the investigation.

Relevance And Context

PBL offers students an obvious answer to the questions, Why do we need to learn this information?" and "What does what I am doing in school have to do with anything in the real world?

Higher-Order Thinking

The ill-structured problem scenario calls forth critical and creative thinking by suspending the guessing game of, What's the right answer the teacher wants me to find?

Learning How To Learn

PBL promotes metacognition and self-regulated learning by asking students to generate their own strategies for problem definition, information gathering, data-analysis, and hypothesis-building and testing, comparing these strategies against and sharing them with other students' and mentors' strategies.

Authenticity

PBL engages students in learning information in ways that are similar to the ways in which it will be recalled and employed in future situations and assesses learning in ways which demonstrate understanding and not mere acquisition. (Gick and Holyoak, 1983).

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parameters for PBL

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While there are many possible formats for presenting problem-based learning units, the following principles remain consistent:

- In a PBL unit, the ill-structured problem is presented first and serves as the organizing center and context for learning.

- The problem on which learning centers:
  - is ill-structured in nature
  - is met as a messy situation
  - often changes with the addition of new information
  - is not solved easily or formulaically
  - does not always result in a right answer
- PBL classrooms: students assume the role of problem-solvers; teachers assume the role of tutors and coaches.
- In the teaching and learning process, information is shared but knowledge is a personal construction of the learner. Thinking is fully articulated and held to strict bench marks.
- Assessment is an authentic companion to the problem and process.
- The PBL unit is not necessarily interdisciplinary in nature but is is always integrative.

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Models of PBL at IMSA

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Problem-based learning is included in the IMSA curriculum in several forms.

To see examples of PBL that have been used at IMSA, select from the following list of courses:

- Science, Society, and the Future
- American Studies
- Biochemistry

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NEstablish The Context For Problem Design

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Priority Conceptual/Skills-Based Outcomes

- understand (Subject) biodiversity (Verb)
- design and conduct experiments
- interpret data
- use graphs to illustrate probability
- communicate effectively with given audience

- understand economic impacts

Significant Characteristics of the Learners -i.e. 12 year olds

- want to be independent -- yet be child-like
- are critical toward society
- are ready to refine reasoning skills
- begin to understand abstract concepts
- develop hero-worships
- can be self-conscious about new tasks

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What is **problem-based learning**?

PBL is an educational format that is centred around the discussion and ***learning*** *that emanates from a clinically-based problem. It is a method that encourages independent* ***learning*** *and gives students practice in tackling puzzling situations and defining their own gaps in understanding in the context of relevant clinical problems, making it more likely that they will be able to recall the material later in the clinical setting. It is a way of* ***learning*** *which encourages a deeper understanding of the material rather than superficial coverage.* PBL adalah suatu format bidang pendidikan yang dikerumuni pelajaran dan diskusi [itu] yang berasal dari suatu masalah clinically-based. [Ini] merupakan suatu metoda yang mendorong pelajaran mandiri dan memberi para siswa praktek mengerjakan membingungkan situasi dan penjelasan gap mereka sendiri di (dalam) pemahaman dalam konteks relevan permasalahan klinis, pembuatan [itu] lebih mungkin bahwa mereka akan mampu mengingat material [itu] kemudian (dalam) pengaturan yang klinis [itu]. [Ini] merupakan suatu [jalan/cara] terpelajar yang mendorong suatu pemahaman [yang] lebih dalam material dibanding/bukannya pemenuhan dangkal.

These PBL web pages contain information and down-loadable resources for students, tutors and people interested in PBL as an educational modality. Please feel free to use the material for non-commercial educational purposes, with appropriate acknowledgment.

TOPICS

- What is PBL?
- Our use of small group, self-directed PBL
- Books and resources to help you with PBL

What is PBL?

Problem-based Learning*: PBL is any learning environment in which the problem drives the learning. That is, before students* ***learn*** *some knowledge they are given a problem. The problem is posed so that the students discover that they need to learn some new knowledge before they* can solve the problem. Some example problem-based learning environments include: Pelajaran Problem-Based: PBL adalah manapun belajar lingkungan di mana masalah [memandu/ mengemudi/ usir] [itu] pelajaran. Itu adalah, [sebelum/di depan] para siswa belajar pengetahuan beberapa [yang] mereka diberi suatu masalah. Masalah diajukan sedemikian sehingga para siswa menemukan bahwa mereka harus belajar beberapa pengetahuan baru [sebelum/di depan] mereka dapat memecahkan masalah [itu]. Beberapa contoh lingkungan pelajaran problem-based meliputi:

•research projects

•*engineering design projects that are more than a synthesis of previously learned knowledge. The traditional and well-known "Case approach", popular with business schools, may or may not be problem-based learning. Often the case is used to integrate previously-learned knowledge and hence would not be, according to this definition, problem-based learning.* oengineering proyek disain yang lebih dari suatu sintese [dari;ttg] pengetahuan sebelumnya [dipelajari/terpelajar]. Terkenal dan yang tradisional " Kasus mendekati", populer di antara sekolah bisnis, boleh atau tidak mungkin pelajaran problem-based. Sering kasus digunakan untuk mengintegrasikan pengetahuan previously-learned dan karenanya tidak akan, menurut definisi ini, problem-based belajar.

• *What's the big deal about PBL? Posing the problem* ***before*** *learning tends to motivate students. They know why they are learning the new knowledge. Learning in the context of the need-to-solve-a-problem also tends to store the knowledge in memory patterns that facilitate later recall for solving problems*.

Apa yang sangat penting sekitar PBL? Menyikapi masalah sebelum pelajaran cenderung untuk memotivasi para siswa. Mereka mengetahui mengapa mereka mempelajari pengetahuan yang baru itu. Belajar dalam konteks kebutuhan untuk memecahkan masalah juga bertujuan untuk menyimpan pengetahuan itu di dalam pola-pola memori yang memudahkan daya ingat kemudiannya untuk memecahkan permasalahan.

• *What skills should a student have before entering a PBL program? They should be skilled at problem solving because that skill in needed as the students try to solve the problem.*

Keterampilan apa yang diperlukan seorang siswa sebelum memasuki suatu program PBL? Mereka harus trampil pada pemecahan masalah sebab bahwa ketrampilan diperlukan dalam hal itu seperti para siswa mencoba untuk memecahkan masalah itu.

• *Does using PBL develop problem solving skills? Not without explicit interventions on the part of the teacher. PBL offers an opportunity to develop the skills*

Apakah penggunaan PBL mengembangkan keterampilan pemecahan masalah? Bukannya tanpa intervensi secara ekplisit pada bagian-bagian pihak guru itu. PBL menawarkan suatu kesempatan untuk mengembangkan ketrampilan itu

• *Is PBL an example of cooperative learning? It depends. If the PBL is an individual project, then it does not require cooperation with others.* Apakah PBL [adalah] suatu contoh belajar koperatif ? Hal itu tergantung. Jika PBL adalah proyek perorangan, kemudian hal itu tidak memerlukan kooperatif dengan orang lain.

• *Why does there seem to be so much confusion about what is and what is not PBL? Problem-based learning, learning because you need to solve a problem, has been around for centuries. Indeed, in the stone age, people learned skills and approaches to solve problems to survive. They just didn't say to each other "Hey, you are using PBL." Similarly, I suggest that all research is PBL, although we don't call it that, we call it research. In the 1960s McMaster Medical School introduced a learning environment that was a combination of small group, cooperative, self-directed, interdependent, self-assessed PBL. Since then this approach has been called "PBL". But PBL, as I suggested previously, can be in any form where a problem is posed to drive the learning. To overcome the confusion, I suggest we use the awkward terminology of small group, self-directed, self-assessed PBL when referring to learning environments similar to the McMaster Medical school approach.* Kenapa [di/ke] sana sepertinya adalah banyak kebingungan tentang apa [yang] adalah dan apa [yang] bukanlah PBL? Pelajaran Problem-based, belajar sebab kamu harus memecahkan suatu masalah, dialami; mengalami selama berabad-abad. Tentu saja, di (dalam) jaman batu, orang-orang mempelajari ketrampilan dan mendekati untuk memecahkan permasalahan untuk survive. Mereka [hanya;baru saja] tidak kata[kan untuk satu sama lain " Hey, kamu sedang menggunakan PBL." [Yang] dengan cara yang sama, aku menyatakan bahwa semua riset adalah PBL, walaupun kita tidak [sebut/panggil/hubungi] ia/nya bahwa, kita [sebut/panggil/hubungi] ia/nya riset. Di (dalam) 1960s Mcmaster Sekolah Medis memperkenalkan suatu belajar lingkungan yang adalah suatu kombinasi [dari;ttg] kelompok kecil, koperasi, PBL self-assessed saling tergantung. Sejak itu pendekatan ini telah [disebut/dipanggil] " PBL". Tetapi PBL, [seperti/ketika] aku mengusulkan sebelumnya, dapat di (dalam) manapun format [di mana/jika] suatu masalah diajukan untuk [memandu/ mengemudi/ usir] [itu] pelajaran. Untuk mengalahkan kebingungan [itu], aku menyarankan kita menggunakan istilah yang canggung [dari;ttg] kelompok kecil, PBL self-assessed self-directed ketika mengacu pada belajar lingkungan yang serupa kepada Mcmaster Pendekatan Sekolah medis.

Small group, self-directed, self-assessed PBL is a use of problem-based learning which embodies most of the principles known to improve learning. This learning environment is active, cooperative, self-assessed, provides prompt feedback, allows a better opportunity to account for personal learning preferences and is highly effective.

• *If small group, self-directed, self-assessed PBL is so great for learning, why isn't everyone doing it? Probably, because of fear of the unknown and resources. Using this approach requires that teachers change. Change is not easy. This change, in particular, expects teachers to change their role from being the center of attention and the source of all knowledge to being the coach and facilitator of the acquisition of that knowledge. The learning becomes student-centered, not teacher-centered. For resources, the McMaster medical school model includes a tutor/teacher with each group. The groups are tutored. Hence, there is one teacher for every group of five or six students. This is resource*

intensive if you do this for only one course. This approach is not so resource intensive ifthe whole program is changed to this format. But what if you want to try small group, self-directed, self-assessed PBL as part of your course? or for only one course in your departmental program? Now, one is faced with classes of 30 to 200 with only one instructor. Jika kelompok kecil, PBL self-assessed self-directed menjadi sangat [yang] besar untuk belajar, mengapa semua orang melakukan itu? Mungkin, oleh karena ketakutan yang yang tak dikenal dan sumber daya. Penggunaan pendekatan ini memerlukan bahwa perubahan para guru. Perubahan tidaklah gampang. Ini ber;ubah, khususnya, harapkan para guru untuk ber;ubah peran mereka dari menjadi;disebut pusat perhatian dan sumber dari semua pengetahuan [bagi/kepada] menjadi;disebut pelatih dan facilitator pengadaan yang pengetahuan. Pelajaran menjadi student-centered, tidak [yang] teacher-centered. Untuk/Karena sumber daya, Mcmaster model sekolah medis meliputi suatu tutor/teacher dengan masing-masing menggolongkan. Kelompok diles-privatkan. Karenanya, ada satu guru untuk tiap-tiap kelompok lima atau enam para siswa. Ini adalah sumber daya yang intensive jika kamu lakukan ini untuk hanya satu kursus. Pendekatan ini tidak demikian sumber daya ifthe intensive program utuh diubah pada format ini . Tetapi akibatnya bagaimana jika kamu ingin mencoba kelompok kecil, PBL self-assessed self-directed sebagai bagian dari kursus mu? atau untuk hanya satu kursus di (dalam) program per departemen mu? Sekarang, satu berhadapan dengan kelas 30 [bagi/kepada] 200 dengan hanya satu instruktur.

• *How can we use this medical school model with only one instructor with large classes of 30 to 300? One answer is to use tutorless groups. Here we provide the students with the training we give to tutors; we empower the student groups to be autonomous and accountable, with the tutor's role being to monitor and hold the individuals and groups accountable for their learning.* o Bagaimana mungkin kita menggunakan sekolah [yang] medis ini model dengan hanya satu instruktur dengan kelas [yang] besar 30 untuk 300? Satu jawaban adalah untuk menggunakan kelompok tanpa mengajar privat. Di sini kita menyediakan para siswa [itu] dengan pelatihan [yang] kita memberi kepada guru privat; kita menguasakan siswa [itu] menggolongkan untuk;menjadi dapat dipertanggungjawabkan dan otonomi, dengan peran guru privat menjadi untuk memonitor dan [memegang/menjaga] kelompok dan individu [itu] bertanggung jawab untuk mereka belajar.

PBL and Problem Solving

Problem solving *is the process used to solve a problem. Since problem-based learning starts with a problem so be solved, students working in a PBL environment should be skilled in problem solving or critical thinking or "thinking on your feet" (as opposed to rote recall). How is this handled? In research programs, we usually have qualifying examinations in which we test the problem solving (thinking skills) of the candidates before they are admitted. In the McMaster Medical school, one of five criteria for admission is a test of the candidates problem solving skills. Regrettably, some teachers embark on PBL without either prescreening or developing their students skill in problem solving.*

Pemecahan masalah adalah proses yang digunakan untuk memecahkan suatu masalah. Karena pelajaran [yang] problem-based mulai dengan suatu masalah maka jadilah dipecahkan, para siswa yang bekerja [adalah] suatu PBL lingkungan harus masalah trampil [yang] memecahkan atau pemikiran kritis atau " pemikiran pada [atas] kaki mu" (sebagai lawan dihafal tanpa pikir

mengingat). Bagaimana ini ditangani? Di (dalam) program riset, kita pada umumnya mempunyai memenuhi syarat pengujian di mana kita menguji masalah [itu] [yang] memecahkan (berpikir ketrampilan) tentang calon [sebelum/di depan] mereka [diakui/diijinkan]. Di (dalam) Mcmaster Sekolah medis, salah satu dari lima ukuran-ukuran untuk pintu masuk adalah suatu test calon yang memecahkan masalah ketrampilan. [Yang] disayangkan, beberapa para guru menaikkan pada [atas] PBL tanpa baik prescreening maupun mengembang;kan ketrampilan para siswa mereka di (dalam) masalah memecahkan.

Doesn't putting students in a PBL environment develop their problem solving skills? Regrettably no. Giving students an opportunity to solve problems rarely develops their skill in problem solving. Can you have problem solving skill development without using PBL? Sure. We have lots of examples. Conventionally, students learn the material in Chapter 5 of a text, and then use problem solving to solve the homework problems. Here students are using problem solving skills in a "subject-based" learning environment compared with a problem-based learning environment. Tidak meletakkan para siswa di (dalam) suatu PBL lingkungan kembang;kan masalah mereka yang memecahkan ketrampilan? [Yang] disayangkan tidak (ada). Beri para siswa [adalah] suatu kesempatan untuk memecahkan permasalahan [yang] jarang kembang;kan ketrampilan mereka di (dalam) masalah [yang] memecahkan. Dapatkah kamu mempunyai memecahkan masalah pengembangan ketrampilan tanpa menggunakan PBL? Pasti. Kita mempunyai kelompok contoh. [Yang] secara konvensional, para siswa belajar material [itu] di (dalam) Bab 5 suatu teks, dan kemudian menggunakan pemecahan masalah untuk memecahkan permasalahan pekerjaan rumah [itu]. Di sini para siswa sedang menggunakan memecahkan masalah ketrampilan di (dalam) a " subject-based" lingkungan pelajaran bandingkan dengan suatu problem-based belajar lingkungan.

PBL and cooperative learning

Cooperative learning is a learning environment where students work together to learn, as opposed to competing with each other for marks. Can you have cooperative learning without PBL? Sure. Cooperative learning can be used for subject-based learning. Here, you ask students to work together to solve problems, discuss ideas, compare ideas about a concept, or do any task. You do use cooperative learning when you use small group, interdependent, self-directed PBL. Can you have PBL without cooperative learning? Sure. Individual research or tasks in the PBL mode do not require cooperative learning.

Our use of small group, self-directed PBL

Our experience has been with small group, self-directed, self-assessed PBL in tutorless groups. In the **chemical engineering program**, we use PBL as part of two courses: one topic or problem in a junior level course; and five topics in a senior level course (Woods, 1991). The students concurrently are taking five to seven required courses presented in the conventional format. Both PBL courses have about 30 to 50 students with one instructor. Hence, we use five to ten tutorless groups with five students per group. Before the students they have received about 50 hours of workshop style training in the processing skills. The outcomes for the PBL activity are the Chemical Engineering subject knowledge (process safety and engineering economics), lifetime learning skills and chairperson skills. Each problem is studied for about one week. Before the first PBL activity, the students have workshopsintroducing them to this PBL approach to learning

and workshops on managing change. The students are required to submit journal reports frequently that make explicit their progress and activities within the PBL tutorless groups. The elaboration is done by having three meetings: a goals meeting, a teach meeting and an elaboration/feedback meeting. Student-generated learning issues are validated by the instructor during the goals meeting. The students' assessment of the partial PBL learning environment, as measured by the Course Perceptions Questionnaire (Knapper, 1994 and Ramsden, 1983), is d= +1 more positive than the responses from a control group of engineering students in a conventional program (N=47).

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In Civil Engineering, Fred Hall uses small group, self-directed, self-assessed PBL in a junior level course; in Geography, Caroline Eyles and Fred Hall use this approach for a senior level project course.

In summary, these are examples of the use of small group self-directed PBL where tutorless groups of five to six students function effectively. The class sizes are in the

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References:

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C. How to... run the enrichment "processing" skills workshops

D. How to... set up courses and course objectives

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XI

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Problem-based learning

From Wikipedia, the free encyclopedia

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Problem-based learning (PBL) is a student-centered instructional strategy in which students collaboratively solve problems and reflect on their experiences. It was pioneered and used extensively at McMaster University, Hamilton, Ontario, Canada. Characteristics of PBL are:

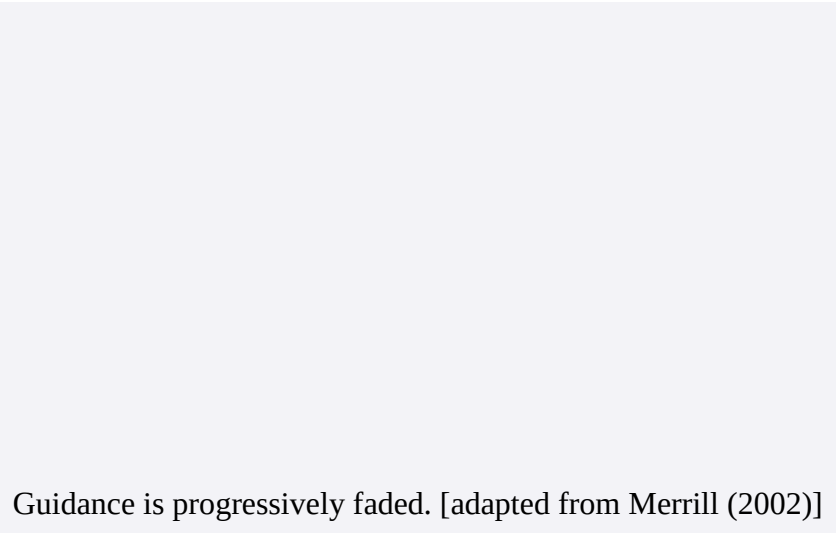
- Learning is driven by challenging, open-ended problems.
- Students work in small collaborative groups.
- Teachers take on the role as "facilitators" of learning.

Accordingly, students are encouraged to take responsibility for their group and organize and direct the learning process with support from a tutor or instructor. Advocates of PBL claim it can be used to enhance content knowledge and foster the development of communication, problem-solving, and self-directed learning skill.

Contents

[hide]

Presenting problems to learners



Guidance is progressively faded. [adapted from Merrill (2002)]

Problem-based learning (PBL) is typically organized with small groups of learners, accompanied by an instructor, faculty person, or facilitator. During this process, a series of problems are provided to learners with guidance early in the PBL process (with introductory problems), and then later guidance is faded as learners gain expertise (Merrill, 2002). Guidance is faded as group members feel more confident with the subject matter and become more competent with the learned procedures.

Merrill (2007) [1] suggests beginning with worked examples and then later, introduce students to smaller less complex problems. But as the process progresses, Merrill suggests changing problems by adding components to make them more realistic (Merrill, 2002, 2007). Thus it is important to begin with simplified versions of real world problems to progressively add components. This progression and fading motivates learners as they slowly gain expertise and take ownership.

During the PBL process learners should discuss problems, define what they know, generate hypotheses, derive learning goals and organize further work. Results may be subsequently presented to larger groups (under guidance from an instructor). A PBL cycle should conclude with learners reflecting on the learning that has taken place.

From a constructivist perspective [Problem-based learning (PBL)], the role of the instructor is to guide the learning process rather than provide knowledge (Hmelo-Silver & Barrows, 2006). From this perspective, feedback and reflection on the learning process and group dynamics are essential components of PBL.

Problem-based learning and cognitive load

Sweller and many others have published a series of studies over the past twenty years that is relevant to problem based learning but concerning cognitive load and what they describe as the guidance-fading effect (Sweller, 2006). Sweller and his associates conducted several classroom-based studies with students studying algebra problems (Sweller, 1988). These studies have shown that active problem solving early in the learning process, is a less effective instructional strategy than studying worked examples (Sweller and Cooper, 1985; Cooper and Sweller, 1987). Certainly active problem solving

is useful as learners become more competent, and better able to deal with their working memory limitations. But early in the learning process, learners may find it difficult to process a large amount of information in a short amount of time. Thus the rigors of active problem solving may become an issue for novices. Once learners gain expertise the scaffolding inherent in Problem based learning helps learners avoid these issues.

Sweller (1988) proposed cognitive load theory to explain how novices react to problem solving during the early stages of learning. Sweller and his associates suggests a worked example early, and then a gradual introduction of problems to be solved. They propose other forms of learning early in the learning process (worked example, goal free problems, etc.); to later be replaced by completions problems, with the eventual goal of solving problems on their own (Sweller, Van Merrienboer, & Paas, 1998). This problem based learning becomes very useful later in the learning process.

Many forms of scaffolding have been implemented in problem based learning to reduce the cognitive load of learners. These are most useful to fade guidance during problem solving. As an example, consider the fading effect helps learners to slowly transit from studying examples to solving problems. In this case backwards fading was found to be quite effective.

Cognitive effects of Problem based learning

The acquisition and structuring of knowledge in PBL is thought to work through the following cognitive effects (Schmidt, 1993):

- initial analysis of the problem and activation of prior knowledge through small-group discussion
- elaboration on prior knowledge and active processing of new information
- restructuring of knowledge, construction of a semantic network
- social knowledge construction
- learning in context
- stimulation of curiosity related to presentation of a relevant problem

Some theories suggest that learning occurs as students collaboratively engage with concepts in meaningful problem solving. In this view, knowledge is seen as a tool for thinking and for enabling learners to participate in meaningful activity.

Problem-based learning is often referred to as a form of Inquiry-based learning (IBL), which describes an environment in which learning is driven by a process of inquiry owned by the student.

Evidence supporting problem-based learning

Hmelo-Silver, Duncan, & Chinn cite several studies supporting the success of the constructivist problem-based and inquiry learning methods. For example, they describe a

project called GenScope, an inquiry-based science software application. Students using the GenScope software showed significant gains over the control groups, with the largest gains shown in students from basic courses. [2]

Hmelo-Silver et al also cite a large study by Geier on the effectiveness of inquiry-based science for middle school students, as demonstrated by their performance on high-stakes standardized tests. The improvement was 14% for the first cohort of students and 13% for the second cohort. This study also found that inquiry-based teaching methods greatly reduced the achievement gap for African-American students.[2]

A systematic review of the effects of problem-based learning in medical school on the performance of doctors after graduation showed clearly positive effects on physician competence. This effect was especially strong for social and cognitive competencies such as coping with uncertainty and communication skills.[3]

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3. ^ Koh, Khoo, Wong, & Koh, The effects of problem-based learning during medical school on physician competency: a systematic review, 2008, CMAJ 178(1)

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External links

- An introduction to PBL, resources, criticism, links
- What is PBL? - Introduction and references
- PBL materials collection
- PBL Directory
- Teaching inquiry-based science: a downloadable guidebook for PBL
- Interdisciplinary Journal of PBL at Purdue
- Penn State's PBL Site
- West Virginia School of Osteopathic Medicine's PBL site
- Kirschner, P. A., Sweller, J., and Clark, R. E. (2006) Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. Educational Psychologist 41 (2) 75-86
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- Problem Based Learning for College Physics (CCDMD)

See also

- project-based learning
- Educational psychology
- Inquiry-based learning
- Learning by teaching (LdL)
- Minnesota State University, Mankato Masters Degree in Experiential Education

II

Definition
Problem-based learning (PBL) is a total approach to education. As defined by Dr. Howard Barrows and Ann Kelson of Southern Illinois University School of Medicine, PBL is both a curriculum and a process. The curriculum consists of carefully selected and designed problems that demand from the learner acquisition of critical knowledge, problem solving proficiency, self-directed learning strategies, and team participation skills. The process replicates the commonly used systemic approach to resolving problems or meeting challenges that are encountered in life and career.

Role Changes
In problem-based learning, the traditional teacher and student roles change. The students assume increasing responsibility for their learning, giving them more motivation and more feelings of accomplishment, setting the pattern for them to become successful life-long learners. The faculty in turn become resources, tutors, and evaluators, guiding the students in their problem solving efforts.

History
Problem-based learning began at McMaster University Medical School over 25 years ago. It has since been implemented in various undergraduate and graduate programs around the world. Additionally, elementary and secondary schools have adopted PBL. The PBL approach is now being used in a few community colleges as well.

Results
Students involved in problem-based learning acquire knowledge and become proficient in problem solving, self-directed learning, and team participation. Studies show that PBL prepares students as well as traditional methods. PBL students do as well as their counterparts from traditional classrooms on national exams, but are in fact better practitioners of their professions.

III

What is Problem-Based Learning?

Dr. De Gallow, Director, Instructional Resources Center,
Project Director, Hewlett Grant

One of the primary features of **Problem-Based Learning** is that it is student-centered. "Student-centered" refers to **learning** opportunities that are relevant to the students, the goals of which are at least partly determined by the students themselves. This does not mean that the teacher abdicates her authority for making judgments regarding what might be important for students to learn; rather, this feature places partial and explicit responsibility on the students' shoulders for their own **learning**. Creating assignments and activities that require student input presumably also increases the likelihood of students being motivated to learn.

A common criticism of student-centered **learning** is that students, as novices, cannot be expected to know what might be important for them to learn, especially in a subject to which they appear to have no prior exposure. The literature on novice-expert **learning** does not entirely dispute this assertion; rather, it does emphasize that our students come to us, not as the proverbial blank slates, but as individuals whose prior **learning** can greatly impact their current **learning** (Scardamalia, Bereiter, 1991) . Often they have greater content and skill knowledge than we (and they) would expect. In any case, whether their prior **learning** is correct is not the issue. Whatever the state of their prior **learning**, it can both aid and hinder their attempts to learn new information. It is therefore imperative that instructors have some sense of what intellectual currency the

students bring with them. One way to determine this is by being witness to how students go about addressing intellectual challenges, especially those that seem at variance with their current understanding. Active, interactive, and collaborative **learning**, on which **Problem-Based Learning** is based, allows an instructor the rare opportunity to observe students' **learning** processes.

The context for **learning** in PBL is highly context-specific. It serves to teach content by presenting the students with a real-world challenge similar to one they might encounter were they a practitioner of the discipline. Teaching content through skills is one of the primary distinguishing features of PBL. More commonly, instructors introduce students to teacher determined content via lecture and texts. After a specific amount of content is presented, students are tested on their understanding in a variety of ways. PBL, in contrast, is more inductive: students learn the content as they try to address a problem.

The "problems" in PBL are typically in the form of "cases", narratives of complex, real-world challenges common to the discipline being studied. There is no right or wrong answer; rather, there are reasonable solutions based on application of knowledge and skills deemed necessary to address the issue [1]. The "solution" therefore is partly dependent on the acquisition and comprehension of facts, but also based on the ability to think critically. What does "critical thinking" refer to? The phrase is often bandied about but seldom defined. For our purposes, critical thinking refers to the ability to analyze, synthesize, and evaluate information, as well as to apply that information appropriate to a given context. It is both critical and creative in that synthesis, in particular, requires the learner to take what information is known, reassemble it with information not known, and to derive a new body of knowledge. Note that we're not necessarily asking students to create new knowledge in the way a practicing scholar does; instead, we're asking students to create something that is at least new to them. (It is not uncommon, for even undergraduates to develop some pretty sophisticated and ingenious solutions.)

The instructor is not passive during student **learning**, but neither does he take the traditional role of "sage on the stage." The instructor's role can be to model different kinds of problem-solving strategies, sometimes referred to as "cognitive apprenticeship" **learning** (Brown, Collins, & Newman, 1989). Students also can model for one another a variety of problem-solving strategies. The most common instructor role is to question the students about their **learning** process by asking meta-cognitive questions: "How do you know that?" "What assumptions might you be making?" These questions are meant to get students to become self-reflective about their **learning** processes, thus another primary feature of PBL is that it is process-centered more so than product-centered. This may seem contradictory as "solving" the problem is an important and critical aspect of PBL—hence its name. The point to be taken here, however, is that while content changes (especially in a rapidly changing technological world), the ability to problem-solve needs to be more portable. No one set of skills will suffice for all time, either; but the ability to generate problem-solving strategies is the skill "with legs." Information trans-ferability is limited by the information available; how to find and create information is limited only by the learner's willingness to participate. PBL, by having students demonstrate for themselves their capabilities, can increase students' motivation to tackle problems.

Problem-based learning is also experiential in that participants experience what it is like to think as a practitioner. How do biologists think? What distinguishes the way a

criminologist might address a problem as opposed to the way a mathematician might? How might these two specialists work together on a problem, a question more germane as disciplines become ever more inter-disciplinary? It is also a question of great concern to employers. Three major complaints from employers about college graduates are graduate's poor written and verbal skills, their inability to problem-solve, and their difficulties working collaboratively with other profes-sionals. PBL can address all three areas.

Defining Characteristics of PBL:

WHAT:	**HOW?**	**WHY?**
Student-centered & Experiential	Select authentic assignments from the discipline, preferably those that would be relevant and meaningful to student interests. Students are also responsible for locating and evaluating various resources in the field.	Relevance is one of the primary student motivators to be a more self-directed learner
Inductive	Introduce content through the process of problem solving, rather than problem solving after introduction to content.	Research indicates that "deeper" **learning** takes place when information is introduced within a meaningful context.
Builds on/challenges prior learning	If the case has some relevance to students, then they are required to call on what they already know or think they know. By focusing on their prior **learning**, students can test assumptions, prior **learning** strategies, and facts.	The literature suggests that **learning** takes placewhen there is a conflict between prior **learning** and new information.
Context-specific	Choose real or contrived cases and ground the count in the kinds of challenges faced by practitioners in the field.	Again, context-specific information tends to be learned at a deeper level and retained longer.
Problems are complex and ambiguous, and require meta-	Select actual examples from the "real life" of the discipline that have no simple answers. Require students to analyze	Requires the ability to use higher order thinking skills such as analysis, synthesis, evaluation, and creation of

cognition	their own problem solving strategies.	new knowledge.
Creates cognitive conflict	Select cases with information that makes simple solutions difficult: while the solution may address one part of a problem, it may create another problem. Challenges prior **learning** as noted above.	The literature suggests that **learning** takes place when there is a conflict between prior **learning** and new information.
Collaborative & Interdependent	Have students work in small groups in order to address the presented case	By collaborating, students see other kinds of problem solving strategies used, they discuss the case using their collective information, and they need to take responsibility for their own **learning**, as well as their classmates'.

[1] These "higher order" thinking skills are attributed to the work of Benjamin Bloom and colleagues (1956) in Bloom's Taxonomy, a hierarchical model of thinking skills.

IV

PROBLEM-BASED LEARNING (PBL)

PBL is a learner-centered educational method.

In PBL learners are progressively given more and more responsibility for their own education and become increasingly independent of the teacher for their education. PBL produces independent learners who can continue to learn on their own in life and in their chosen careers. The responsibility of the teacher in PBL is to provide the educational materials and guidance that facilitate **learning**.

PBL is based on real world problems

In PBL **learning** is based on the messy, complex problems encountered in the real world as a stimulus for **learning** and for integrating and organizing learned information in ways that will ensure its recall and application to future problems. The problems in PBL are

also designed to challenge learners to develop effective problem-solving and critical thinking skills.

The PBL learning process

In the PBL learning process learners encounter a problem and attempt to solve it with information they already possess allowing them to appreciate what they already know. They also identify what they need to learn to better understand the problem and how to resolve it.

Once they have worked with the problem as far as possible and identified what they need to learn, the learners engage in self-directed study to research the information needed finding and using a variety of information resources (books, journals, reports, online information, and a variety of people with appropriate areas of expertise). In this way learning is personalized to the needs and learning styles of the individual.

The learners then return to the problem and apply what they learned to their work with the problem in order to more fully understand and resolve the problem.

After they have finished their problem work the learners assess themselves and each other to develop skills in self-assessment and the constructive assessment of peers. Self-assessment is a skill essential to effective independent learning.

The PBL curriculum

The series of problems encountered by learners with this process make up the curriculum. The problems are put together as a group to stimulate learning of content appropriate to the course. In the PBL process learners characteristically learn far more and in areas relevant to their personal needs.

The role of the PBL teacher

The principle role of the teacher in PBL is that of a facilitator or educational coach (often referred to in jargon of PBL as a "tutor") guiding the learners in the PBL process. As learners become more proficient in the PBL learning process the tutor becomes less active. This is a new skill for many teachers and specific training is required. (See workshops)

The learning group

Learning is ideally in small groups of 5 to 7 learners. As the group members work together to problem solve and learn they acquire collaborative or team learning skills. In some settings, as in secondary education, learner groups may initially be much larger (15-35). But techniques can be used to compensate for the disadvantages of such larger groups.

PBL is a motivating way to learn

PBL is a motivating way to learn as learners are involved in active learning, working with real problems and what they have to learn in their study is seen as important and relevant to their own lives.

The objectives of PBL is to produce learners who will:

- Engage the problems they face in life and career with initiative and enthusiasm.
- Problem-solve effectively using an integrated, flexible and usable knowledge base.
- Employ effective self-directed learning skills to continue learning as a lifetime habit.
- Continuously monitor and assess the adequacy of their knowledge, problem-solving and self-directed learning skills.
- Collaborate effectively as a member of a group.

The PBL method developed by the PBLI and used at Southern Illinois University (SIU) is "authentic" and has a number of unique factors not found in many PBL approaches.

By definition, authentic learning involves the learner in activities and skills that are valued and used in the real world. This PBL method is authentic as:

- The problems used are ill-structured messy problems like those the learner will encounter in the real world.
- The learning process requires the skills expected of learners when they encounter problems in their lives and careers.

These are factors unique to the SIU approach:

- The development of problem-solving skills is directly addressed in both the design of the problems used and facilitatory skills employed by the tutors.
- The PBL process is learner-centered at every step. At no time are learners told what they should learn or what resources they should use.
- A major part of learner assessment in the curriculum is based on self and peer assessment.
- Formal assessment in the curriculum is based on learner performance in problem solving and self-directed learning and the extent and depth of knowledge associated with a problem.
- The performance of students in the PBL curriculum has been compared with that of students in the school's standard curriculum longitudinally over three years. Longitudinal Assessment of SIU Problem-Based Learning.

For more information about PBL refer to educational resources and the bibliography.

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V

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PROBLEM-BASED LEARNING

Definition

Problem Based Learning (PBL) is a term used within education for a range of pedagogic approaches that encourage students to learn through the structured exploration of a research problem. Reworking the familiar lecture/tutorial model, students work in small self-directed teams to define, carry out and reflect upon a research task, which can often be a 'real-life' problem. The tutor acts as a facilitator and resource person to whom they can come to for advice or guidance. It is used in a variety of disciplines and teaching situations, whether within one course unit or to deliver a whole degree curriculum, and with undergraduates just as much as postgraduates. Some commentators adopt an evangelical approach to 'marketing' the PBL acronym and approach, and seek to distinguish pure 'PBL' from a broader set of related approaches that they label 'pbl'. This overview questions such a distinction.

Background

Team-work, problem solving and independent thinking are invaluable skills for everyday life. **Problem Based Learning** (PBL) is a term describing techniques that make students take an active, task-oriented, and self-directed approach to their own **learning**. It can also provide students with insights into the research process. There are a variety of different approaches that travel under the PBL moniker. The model adopted is less important than the intention – namely that problems, tasks and unexpected situations form the starting point for **learning**. The classic PBL model was developed in the 1960s within medical education, and is sometimes criticised for having a rather inflexible and linear structure. This C-SAP synopsis describes how it can be adapted for use within the social sciences, encourages you (as a tutor or student) to experiment and change the model to suit your needs, and discusses the issues and problems you might encounter.

How is '**Problem Based Learning**' different from other forms of **learning**? A simplistic distinction might be that in 'traditional' curricula teachers tend to start by providing information, and then expect students to use the information to solve problems. In a **problem- based** approach to **learning** the problem comes first. Students both define the problem and gather information to explore it. Working in self-directed groups, students thus take an active and systematic approach to defining and exploring a research problem. They are not expected to reach the 'right' answer. There may not be right answers. The technique is characterised by the juxtaposition of individual and collective analytical

work, combining team-based exploration and synthesis with individual research and analysis.

The Research Evidence

PBL became a feature of medical education during the 1960s, and has since been taken up in fields of professional training (eg nursing, architecture, engineering). Its adoption within the humanities and social sciences is much less developed, and it has been argued that it is easier to use in 'applied disciplines'. Such a view is however likely to be the consequence of different disciplinary traditions, cultures of teaching and views about the status of knowledge. It is also the case that many in the social sciences see themselves as already teaching using a **problem-based** approach, though such approaches are rarely benefit from the structured integration of individual and group work that PBL advocates.

There are a number of different approaches which journey under the title of **problem-based learning**, leading some to distinguish an 'authentic' PBL which sticks closely to a set of particular set of principles and processes first systematized by medical educationalists at McMaster University. Other writers feel that there can never be one single approach to all teaching and **learning** contexts, pointing out that the label itself objectifies a single technique as 'the' answer to a complex set of pedagogic issues. Much of the PBL literature adopts an evangelical tone and this has led to hostility in some quarters, together with a strong defense of the values of 'traditional' teaching methods. Concern has also been expressed that PBL is being used as as a way of reducing the costs of teaching. Perhaps it is best seen as one of a number of moves towards making **learning** more student-centred, experiential and activity-based. As an approach PBL has both advantages and disadvantages. It is certainly not a short-cut, and requires careful preparation and facilitation, a supportive curriculum structure in which the **learning** process is prioritised, and thought given to appropriate assessment criteria.

The move to 'evidence-based' practice, particularly within medicine, has led to attempts at reviewing the efficacy of PBL as a teaching practice in comparison with other teaching and **learning** styles. In general, the research is still inconclusive, and very little has been carried out in the social sciences. Large-scale reviews suggest that PBL may increase skills-levels, but may result in poorer performance on traditional tests of subject knowledge. Some suggestion has been made that it is also unrealistically demanding in terms of resources. Other research has suggested that it can be enjoyable and nurturing, but also stressful for students. Useful further reading includes Boud and Feletti (1997), Savin-Baden (2000) and the research resources assembled at the web-sites listed below.

Putting it into Practice

One way of using PBL in your courses (there is no right way!) involves holding two linked workshops/seminars, each lasting an hour (or more), usually held a week apart. In the first session the group is given a carefully-chosen "trigger" problem or scenario. This may be a sentence, a picture or even an object - anything which provokes discussion around a topic. Careful choice of a focused "trigger" will ensure that students will

explore a research problem relating to the course or module outcomes, or the substantive teaching topic. You may find that you want to give the students more focus by actually giving them a research problem, rather than expecting them to define it. As with the choice of trigger, this requires careful preparation of a focused research problem.

After appointing a chairperson and a note-taker, the participants "brainstorm" possible research topics leading out of the trigger. After discussion, the group define a researchable "problem", and analyse ways of exploring different angles to this problem, and then set themselves research tasks leading out of it. You might want to suggest that they come up with three research aims for the week, such as a review of the relevant literature, preparing a short bibliography, or carrying out an interview, The tutor acts as a resource person, suggesting readings or sources of information, but not intervening in the group discussion unless necessary. The tutor may not even want to sit in on the whole session. The group return a week later to pool their new knowledge about the topics they've set themselves, and reflect on the original research aims they set themselves.

Building on teaching experience, we have adapted the PBL process to five stages. These stages provide a semi-structured framework for students to work with, but you may want to adapt this framework to suit your needs. **Learning** is not linear, and neither is PBL, so encourage students to recognise that they might find themselves going back and forth between different three stages

The following PBL stages present one way of using PBL. Stages 1 –3 can be used at a first hour-long session, session 4 over the subsequent few days, and Stage 5 at the second session – which may take longer. Adjust the times to suit your needs)

- STAGE 1: DEFINITION (10 mins)
    - Appoint chairperson and notetaker. Discuss first reactions to trigger provided by tutor.
    - What sense does the group make of the trigger?
    - What possible research problems lead from the trigger? List them.
- STAGE 2: ANALYSIS (30 mins)
    - ‘Brainstorm’ these possible research problems.
    - What explanations or interpretations are there in the group about these problems?
    - Which explanation/interpretations seem most useful and why?
- STAGE 3: RESEARCH AIMS (15 mins)
    - Formulate the key research problem /hypothesis for investigation
    - What further knowledge does the group need to explore this problem?
    - Define three specific research tasks to be completed. Divide up tasks.
    - Agree on how the group will work together during the week - eg email contact?
- STAGE 4: RESEARCH (Set a limit to time for independent work, eg three hours)
    - Acquire knowledge in relation to research questions
    - Group or individual research over the week, limited to 3 hours

    - Complete task eg preparation of an annotated bibliography of material related to the problem for the other groups.
- STAGE 5: SYNTHESIS (In a second session, usually 1-2 hours long)
    - Review the newly acquired knowledge within the group.
    - Pool findings - do they help an understanding of the research problem?
    - Final group response to the trigger.
    - Reflections on the **learning** process

Issues and Debates

What are the advantages of this approach to learning?
It provides a flexible **learning** process, enabling students to decide and prioritise their own **learning** agenda. It gives students a chance to draw on their own experiential knowledge, and allows them to reflect on the very process of their own thinking and meaning-making. It can make them more goal-oriented, seeing their work in a larger perspective, and is an excellent introduction to the research process. In PBL one is allowed to make mistakes and learn from them. Finally, group interaction enables individuals to see the many perspectives on a problem. All of these are valuable professional and team-working skills for life beyond university.

Does it have disadvantages for students?
Research has shown that whilst this style of student-centred **learning** can be enjoyable and nurturing for students, it is also very different to the teaching they have already received, and so can be stressful and disorienting. Students are no longer given the "answers", and this can require a change in attitude and mind-set. Some practitioners recommend that it should be introduced in a student's first year on a course.

TEACHING ISSUES:

What role does the tutor play?
The tutor adopts the role of 'information broker' during the **learning** process, not adopting a directive stance, but responding with guidance as necessary. He or she may not need to be with the group all the time One writer compares the role of tutor to that of team "coach", motivating and guiding from the sidelines! There may be occasions where the tutor intervenes if he/she thinks that the students are not focusing sufficiently, or are having problems defining a research problem to investigate or deciding on their research tasks. Again, the tutor can define the level of direction he or she thinks appropriate.

Should PBL replace other forms of teaching such as lectures?
PBL can be used at all levels to complement or replace other methods. For those new to a discipline, PBL works most effectively when used to build on and develop ideas presented in lectures or readings. There is no reason why an initial short lecture could not be part and parcel of a PBL session. For more advanced undergraduates and postgraduates, PBL can be an energising and rewarding alternative to the lecture/tutorial approach. It can be used either as another tool in a teaching repertoire or as a means of delivering a whole course.

Does it take more time and resources?
The semi-structured nature of the PBL requires different demands of tutor time and resources, and may well involve extensive preparation. The tutor will have to think about the different types of information resources the students might make use of, particularly given the increasing number of web-based resources. This might require the preparation of briefing notes for the students, a longer reading list, or advice on search strategies. The tutor may want to be available (in office hours or via email) during the week when the students are pursuing their research tasks.

Can one use it in large classes?
A large class puts different demands on the resource person, especially as eight to ten participants are the ideal number for a PBL group. One can however divide a larger class into several PBL teams, and move from one group to another providing guidance and advice. The student groups can of course report back to a larger plenary session, sharing their insights both orally and in the form of circulated reports.

What about assessment?
PBL can be assessed like other group project work, with individual and group contributions being marked. PBL is most likely to be successful if it is closely integrated into the course design. Curriculum content, **learning** outcomes and approaches to assessment are all interlinked, and will all need to be considered, along with the staff development needs that the introduction of PBL might imply.

What is the Trigger?
The process usually starts with what some call a 'trigger', often a specific sentence or paragraph that opens up an issue, sparks a debate, begs a question or hints at a problem. It is important to have a tightly focused trigger to focus students onto a specific topic - inevitably discussions will diverge and become more broad. The tutor will probably choose a trigger that relates in some way to a substantive course topic or **learning** outcome. Alternatively, the tutor may just want to set the students a specific problem, and skip the use of a trigger.

Examples of triggers might include a quotation from an interview, a citation from an article or book, a set of statistics, an image or article from a newspaper or magazine, a video clip or a "found" object. There is no restriction to the sort of trigger that might be used – and experience will show what works well. One anthropologist used quotations from fieldwork informants to provide examples of "lived experience" that led to research problems being formulated.

Resources

Coventry University / LTSN PBL site : www.hss.coventry.ac.uk/pbl/

This site has a variety of resources, details upcoming events, and has an insightful reserach paper by Savin-Baden and Wilkie

Research into PBL site: www.hebes.mdx.ac.uk/teaching/Research/PEPBL

This site details a current systematic review and evaluation into the efficacy of PBL within the Nursing curriculum

OTHER WEB RESOURCES :

Centre for Instructional Support, University of Colorado: http://www.uchsc.edu/CIS/PBL.html

University of Maastricht PBL site (A founder of the PBL model, with a wide variety of resources available): www.unimaas.nl/pbl/

Australian PBL teaching & research network
University of Newcastle (comprehensive PBL bibliography): http://www.newcastle.edu.au/services/iesd/learndevelop/problarc/

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VI

PROBLEM-BASED LEARNING

As an MBA, you will have to be an accomplished problem-solver of organizational design and change situations. You will also have to be a self-directed learner your entire professional life, as knowledge in the field of management will change, and you will continuously be meeting new and unexpected challenges.

The consideration of these factors such as these dictates the wisdom of a **problem-based**, student-centered, self-directed program that will allow you, the student, in collaboration with your group and instructor, to design an experience tailor-made to your individual needs.

What Is Problem-Based Learning (PBL)?

Problem-based learning (PBL) is an approach that challenges students to learn through engagement in a real problem. It is a format that simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem-solvers confronted with an ill-structured situation that simulates the kind of problems they are likely to face as future managers in complex organizations.

Problem-based learning is student-centered. PBL makes a fundamental shift--from a focus on teaching to a focus on **learning**. The process is aimed at using the power of authentic problem solving to engage students and enhance their **learning** and motivation. There are several unique aspects that define the PBL approach:

- **Learning** takes place within the contexts of authentic tasks, issues, and problems--that are aligned with real-world concerns.
- In a PBL course, students and the instructor become colearners, coplanners, coproducers, and coevaluators as they design, implement, and continually refine their curricula.
- The PBL approach is grounded in solid academic research on **learning** and on the best practices that promote it. This approach stimulates students to take responsibility for their own **learning**, since there are few lectures, no structured sequence of assigned readings, and so on.
- PBL is unique in that it fosters collaboration among students, stresses the development of problem solving skills within the context of professional practice, promotes effective reasoning and self-directed **learning**, and is aimed at increasing motivation for life-long **learning**.

Problem-based learning begins with the introduction of an ill-structured problem on which all **learning** is centered. The problem is one that MBA students are likely to face as future professionals. Expertise is developed by engaging in progressive problem solving. Thus, problems drive the organization and dynamics of the course. MBA students, individually and collectively, assume major responsibility for their own **learning** and instruction. Most of the

learning occurs in small groups rather than in lectures. As teacher, my role changes from "sage on stage" to a "guide by the side." My role is more like that of a facilitator and coach of student **learning**, acting at times as a resource person, rather than as knowledge-holder and disseminator. Similarly, your role, as a student, is more active, as you are engaged as a problem-solver, decision-maker, and meaning-maker, rather than being merely a passive listener and note-taker.

Where Did PBL Come From and Who Else is Using It?

PBL originated from a curriculum reform by medical faculty at Case Western Reserve University in the late 1950s. Innovative medical and health science programs continued to evolve the practice of PBL, particularly the specific small group **learning** and tutorial process that was developed by medical faculty at McMaster University in Canada. These innovative and forward-looking medical school programs considered the intensive pattern of basic science lectures followed by an equally exhausting clinical teaching program to be an ineffective and dehumanizing way to prepare future physicians. Given the explosion of medical information and new technology, as well as the rapidly changing demands of future medical practice, a new mode and strategy of **learning** was developed that would better prepare students for professional practice. PBL has spread to over 50 medical schools, and has diffused into many other professional fields including law, economics, architecture, mechanical and civil engineering, as well as in K-12 curricula. And the entire MBA program at Ohio University has been designed as an integrated curriculum using the PBL approach.

Why PBL?

Traditional education practices, starting from kindergarten through college, tend to produce students who are often disenchanted and bored with their education. They are faced with a vast amount of information to memorize, much of which seems irrelevant to the world as it exists outside of school. Students often forget much of what they learned, and that which they remember cannot often be applied to the problems and tasks they later face in the business world. Traditional classrooms also do not prepare students to work with others in collaborative team situations. The result: students tend to view MBA education as simply a "right of passage," a necessary "union card," and an imposed set of hurdles with little relevance to the real world. Education is reduced to acquiring a diploma (merely another commodity to be purchased in the marketplace), and the final grade becomes the overriding concern (rather than **learning**).

Research in educational psychology has found that traditional educational approaches (e.g., lectures) do not lead to a high rate of knowledge retention. Despite intense efforts on the part of both students and teachers, most material learned through lectures is soon forgotten, and natural problem solving abilities may actually be impaired. In fact, studies have shown that in 90 days students forget 90% of everything they have been told (Smilovitz, 1996). Motivation in such traditional classroom environments is also usually low.

Perhaps one of the greatest advantages of PBL is that students genuinely enjoy the process of **learning**. PBL is a challenging program which makes the study of organization design and change intriguing for students because they are motivated to learn by a need to understand and solve real managerial problems. The relevance of information learned is readily apparent; students become aware of a need for knowledge as they work to resolve the problems.

How Does PBL Work?

A PBL course is designed into a series of real-world, hands-on, PBL investigations. You will be working in small groups/teams with other students on problems that you are likely to encounter as a professional manager. You will begin a PBL investigation by being presented with an ill-

structured organizational problem or scenario. Such a presentation may be in the form of a written statement, a video clip of a real manager at a company, or a guest speaker. Every PBL team will appoint a chairperson/leader and sometimes a recorder/secretary. Your PBL team will be guided in the use of a reiterative problem-solving process. Your team will applyy this problem solving process to find, analyze, and solve the presenting problem. Some PBL investigations may culminate in a student-created project/product, exhibitions, or other artifacts that address the driving questions. In some cases, the PBL investigation will culminate in an oral performance with managers from the business community in attendance.

As you work with each problem you can:

1. Develop your diagnostic reasoning and analytical problem-solving skills.
2. Determine what knowledge you need to acquire to understand the problem, and others like it.
3. Discover the best resources for acquiring that information.
4. Carry out your own personalized study using a wide range of resources.
5. Apply the information you have learned back to the problem.
6. Integrate this newly acquired knowledge with your existing understanding.

In short, you will be **learning** in a highly relevant and exciting manner to problem-solve and to develop self-directed study skills that build toward the skills and knowledge that you will need as a practicing manager.

The problem-solving process can be summarized according to three broad and reiterative phases.

Phase 1. First, your group will gather information and list it under a heading entitled: "What do we already know?" In this phase, you will entertain the problem in light of the knowledge that you already have from your own experience. Your group will discuss the current situation surrounding the problem as it has been presented. This analysis requires discussion and agreement on the working definitions of the problems, and sorting out which issues and aspects of the situation are worthy of further investigation. This initial analysis should yield a problem statement that serves as a starting point for the investigation, and it may be revised as assumptions are questioned and new information comes to light.

Phase 2. Next, you will engage with the problem by also identifying under a second heading, "What do we need to know (to solve this problem)?" Here you will list questions or **learning** issues that must be answered to address missing knowledge, or to shed light on the problem. It is in this phase that your group will be analyzing the problem into components, discussing implications, entertaining possible explanations or solutions, and developing working hypotheses. This activity is like a "brainstorming" phase with evaluation suspended while explanations or solutions are written on a flipchart or chalkboard. Your group will need to formulate **learning** goals, outlining what further information is needed, and how this information can best be obtained.

Phase 3. The above list should inform your group in what to do in order to solve the problem. In this phase your group will discuss, evaluate, and organize hypotheses and tentative hypotheses. Your group will make a "What should we do?" list that formulates keeps track of such issues as what resources to consult, people to interview, articles to read, and what specific actions team members need to perform. It is in this phase that your group will identify and allocate **learning** tasks, develop study plans to discover needed information. You will be gathering information from the classroom, resource readings, texts, library sources, videos, and from external experts on the subject. As new information is acquired, your group will need to meet to analyze and evaluate it for its reliability and usefulness in applying it to the problem.

In short, you will be spending a great deal of time discussing the problem, generating hypotheses, identifying relevant facts, searching for information, and defining their own **learning** issues. Unlike traditional and standard classes, **learning** objectives are not stated up front. Rather, you and members of your group will be responsible for generating your own **learning** issues or objectives based on your group's analysis of the problem.

All during this process, as a student, you will be actively defining and constructing potential solutions. As an instructor, my role is primarily to model, guide, coach--to support you and your team through the **learning** and assessment process.

The majority of class time will be devoted to working in self-directed, PBL small group tutorials. A portion of class time will be allocated to "Resource Sessions," which may include simulations, case studies, and brief discussions to further explore concepts and issues which arise out of the PBL projects.

Transitioning to a PBL Classroom Environment

Students who are new to a PBL classroom environment may find it initially unsettling. This is because you are being asked to take responsibility for your own **learning**, to work on ill-structured problems where there isn't a pre-established "right answer," and where you are expected to structure your own approach to acquiring and using information to solve problems. In many respects, this environment mimics the "real-world." In business settings, there are no standardized objective tests, lectures, or routine and well defined assignments. Entering this new type of **learning** environment requires you a willingness on your part to accept risk and uncertainty, and to become a self-directed learner.

Establishing an Open Climate for PBL

Establishing an open climate is essential for **problem-based learning**. Every student should feel free to say whatever comes to mind, any ideas or comments, no matter how unsophisticated or inappropriate they might seem, without being put down or criticized. Most students have learned in their prior educational experiences not to speak up or volunteer their thoughts unless they are absolutely sure of the answer. Any show of ignorance was held against them.

Learning can never occur unless you can bring out their ideas and thoughts, and openly admit to confusion, lack of understanding, or ignorance…"I don't know" is a powerful first step to **learning**. The same is true for myself as the instructor. The instructor doesn't have all the answers or know everything; no one person can be an authority in everything, and no one should be expected to have all the answers. We can ALL learn in this course.

It is your responsibility, as a student, TO SPEAK UP when you are doubtful, unsure, or uncomfortable with comments or ideas made by others in the group. You also must be willing to speak up when you feel that another member of your group is making statements that you feel are incorrect.

Students must also develop the ability to openly and constructively express their opinions about the comments or ideas of others, or about the quality of other students' performance in the group. It is your responsibility to offer opinions in a friendly and constructive manner. Every student must learn to both *give* and *accept* constructive criticism.

PBL Assessment Philosophy

To Assess. The Latin origin of this term, *assidere*, literally means *to sit down beside.* Another way of thinking of assessment is to use careful judgment based on the kind of close observation that comes from "sitting down beside."

With PBL, assessment is not separate from instruction. Rather, assessment is integral to **learning**. The focus and purpose of assessment is *on* ***learning***, on how it is done, and how it can be better, not on normative comparisons. Assessment is a continuous process that drives instruction. Further, assessment does not bring an end to **learning**; it provides information about how to continue to develop your skills, knowledge and abilities with respect to the course **learning** objectives. Having said this, it is important for you to think of assessment as an *active demonstration of your understanding and ability to apply this understanding.*

Words like "tests" and "examinations" have well established connotations of evalutating a student's *possession* of knowledge. We need a different process, and a new language, to identify how to assess a student's capability for *using* and *applying* knowledge. Education of an individual, understood in terms of developing a capbility for using and applying one's knowledge, cannot be adequately assessed by traditional testing. Grading on a curve, which sorts students into groups for administrative purposes, says nothing about how each student is using his or her talents or growing toward their potential.

With PBL, the instructor is no longer the sole yardstick by which your progress will be measured. Rather, my role as instructor is to help students monitor themselves, to monitor your own progress, to establish criteria for **learning** and quality work, and to help you devise your own goals for improvement. This means that I will not be the only judge of student work; students will learn to evaluate the work of their peers, as well as their own. In addition, your work may also be monitored and evaluated by real-world assessors--managers and executives from companies in the Bay Area.

Students will codevelop with the instructor relevant and meaningful assessments, and play an active role in developing criteria and setting standards of performance for high quality work. Assessments must have meaning for the learner. For assessments to be meaningful, they must have some connection to the real world, difficult enough to be interesting but not totally frustrating, and generative, where a real product, service, or valued information is being evaluated. This concept of assessment-as-**learning** focuses on what *learners achieve*--not what *teachers provide.*

Therefore, in this course, student assessment is a multidimensional process, integral to **learning**, that involves observing performances of individual learners in action and judging them on the basis of collaboratively determined developmental criteria, with resulting feedback to that learner. Assessments may involve a performance or demonstration, usually for a real audience (i.e., managers from the business community) and useful purpose (e.g., as part of student exhibition or **learning** conference). Assessment must be seamless and ongoing; it must be part of the PBL process. Students must also learn during assessment; it is not simpy a "grade" that is tacked on at the end of a paper or transcript.

In general, and at minimum, students will be assessed in three broad areas:

1. *Applied Competence.* Demonstrate the ability to use organizational design and change management concepts and frameworks to identify and anaylze variables that can influence an organization's overall effectiveness.
2. *Critical Thinking, Problem-Solving and Communicative Competence.* Identify problems and/or opportunities in organizational contexts and make specific recommendations, supported by theory, to improve the situation. Accurately and competently using theoretical frameworks from organization design and change literature to interpret and

solve business problems, and effectively communicating your analyses to others in a variety of professional contexts. Implementing your problem solving activities with a commitment to quality.

3. *Collaborative and Leadership Competence.* Collaborates as a member of a project team, taking the initiative in identifying and solving problems or pursuing opportunities for **learning** and improvement within your group.

Assessment must also be seen as fair and equitable. In the early part of the semester, a voluntary "student assessment task force" will be formed. This task force will consists of student representatives from each of the three sections of MGMT 842 and will work with the instructor in developing an overall assessment plan for all three sections. After every PBL project, group-based assessments will be conducted. These assessments are to help facilitate reflection on what you learned during the PBL project, and to receive direct feedback from your team members on your performance, contributions, and intellectual achievements.

VII

Introduction to PBL

This tutorial will:

- Define **Problem-Based Learning**
- Describe ill-structured problems in PBL
- Discuss the roles of teachers and students in PBL
- Delineate the benefits of PBL
- Clarify the parameters of PBL
- Present organizational options for PBL
  -
  - SSF
  - Biochemistry
  - American Studies

What is PBL ?

- Next >

What is PBL?

Problem-based learning (PBL) is a curriculum development and instructional approach.

What does PBL do?

PBL simultaneously develops problem solving strategies, disciplinary knowledge bases, and skills.

How does PBL do it?

By placing students in the active role of problem-solvers confronted with an ill-structured problem which mirrors real-world problems.

Problem-based learning has as its organizing center the ill-structured problem that ...

- is messy and complex in nature
- requires inquiry, information-gathering, and reflection
- is changing and tentative
- has no simple, fixed, formulaic, right solution

Examples of ill-structured problems used in PBL

You are:

- a scientist at the state department of nuclear safety. Some people in a small community feel their health is at risk because a company keeps thorium piled above ground at one of their plants. What action, if any, should be taken?

  Summer Challenge 1992, IMSA

- a consultant to the Department of Fish and Wildlife. A first draft of a plan for the reintroduction of wolves to Yellowstone has received strong, negative testimony at hearings. What is your advice regarding the plan?

  John Thompson, Ecology, IMSA

- a science advisor at NASA. A planet much like the earth has experienced massive destruction of elements of its biosphere. What is causing the destruction of plant life? Can new plants from earth be successfully introduced to help save the planet's environment?

  Bill Orton, 2nd grade, Williamsburg, VA

- a thirty-six year old single working mother with a five year old daughter. Upon your husband's death, you receive $20,000 in worker's compensation and $10,000 in stock option shares. How can you invest this money so that by your daughter's 18th birthday, its growth is maximized?

  LuAnn Malik, Community College of Aurora, Aurora, CO

- a member of President Truman's Interim Committee. What advice will you give the President to help end the war in the Pacific? An atomic bomb has just been detonated at Los Alamos.

  Bill Stepien, American Studies, IMSA

- invited to participate in a special session of your school board to determine whether Huckleberry Finn should be taught in your school district given its inclusion on a state censorship list.

  Ed Plum, American Literature, District #214, Barrington, IL

- a stockholder of a major oil refinery in Louisiana which has mined oil from wetlands in the southern part of the state. You have received pressure from publicity about the wetlands to make it property of the federal government so that it can be protected. What will you do?

  Christine Vitale, 4-5 multi-grade, Arlington Heights, IL

- the principal of Foggeybottom High School asked by the school board to present a new comprehensive blue-print for all teachers to use at the school. What will your plan look like? What rationale will you give for the plan?

  Diana Weidenbacker, Winnacunnet Alternative School, Winnacunnet, NY

How does PBL compare with other instructional approaches?

- < Last |
- Next >

Considerations:

- role of the problem
- role of the teacher
- role of the learner

Problem-based learning **begins** with the introduction of an ill-structured problem on which all learning **centers**. Teachers assume the role of cognitive and metacognitive coach rather than knowledge-holder and disseminator; students assume the role of active problem-solvers, decision-makers, and meaning-makers rather than passive listeners.

Problem-Based Learning causes a shift in roles...

Teacher as coach

Models/coaches/fades in:

- Asking about thinking
- Monitoring learning

- Probing/challenging students' thinking
- Keeping students involved
- Monitoring/adjusting levels of challenge
- Managing group dynamics
- Keeping process moving

Student as active problem-solver

- Active participant
- Engaged
- Constructing meaning

Problem as initial challenge and motivation

- Ill-structured
- Appeals to human desire for resolution/stasis/harmony
- Sets up need for and context of learning which follows

What are the benefits of PBL?

- < Last |
- Next >

Motivation

PBL makes students more engaged in learning because they are hard wired to respond to dissonance and because they feel they are empowered to have an impact on the outcome of the investigation.

Relevance And Context

PBL offers students an obvious answer to the questions, Why do we need to learn this information?" and "What does what I am doing in school have to do with anything in the real world?

Higher-Order Thinking

The ill-structured problem scenario calls forth critical and creative thinking by suspending the guessing game of, What's the right answer the teacher wants me to find?

Learning How To Learn

PBL promotes metacognition and self-regulated learning by asking students to generate their own strategies for problem definition, information gathering, data-analysis, and

hypothesis-building and testing, comparing these strategies against and sharing them with other students' and mentors' strategies.

Authenticity

PBL engages students in learning information in ways that are similar to the ways in which it will be recalled and employed in future situations and assesses learning in ways which demonstrate understanding and not mere acquisition. (Gick and Holyoak, 1983).

Parameters for PBL

- < Last |
- Next >

While there are many possible formats for presenting problem-based learning units, the following principles remain consistent:

- In a PBL unit, the ill-structured problem is presented first and serves as the organizing center and context for learning.
- The problem on which learning centers:
  - is ill-structured in nature
  - is met as a messy situation
  - often changes with the addition of new information
  - is not solved easily or formulaically
  - does not always result in a right answer
- PBL classrooms: students assume the role of problem-solvers; teachers assume the role of tutors and coaches.
- In the teaching and learning process, information is shared but knowledge is a personal construction of the learner. Thinking is fully articulated and held to strict bench marks.
- Assessment is an authentic companion to the problem and process.
- The PBL unit is not necessarily interdisciplinary in nature but is is always integrative.

VII

PROBLEM-BASED LEARNING

Problem-Based Learning engages students with fuzzy, messy problems such as we encounter in real life. Students work in teams with projects they develop based on higher order thinking, collaboration, communication, and "just-in-time" learning of content and skills. In the current climate of standards and frameworks, this is a powerful teaching method for addressing a number of standards simultaneously and economically. Portfolio assessment relates

Problem-Based Learning to particular frameworks and benchmarks. Explore the links below to learn more and see examples of this strategy, currently used in about 80% of medical schools, as well as K-12!

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1. What Is PBL? -- Superb resource from San Diego State University with advice on every aspect of PBL; follow the "next page" buttons.
2. The Center for Problem-Based Learning
3. Project Based Learning
4. PROBLEM-BASED LEARNING -- Great site with teacher education information, as well
5. INQUIRY-BASED LEARNING -- Sites to explore open-ended teaching
6. WebQuests and Problem-Based Learning -- Great ideas and examples! -- Variety of articles from experiences with PBL at the university level
7. Project-Based Learning
8. Project Based Learning: What Works
9. THE PROJECT APPROACH TO LEARNING IN ECE -- See it "live" at the ALL School in Worcester
10. Disadvantages of Problem Based Learning Realistic survey of some of the obstacles that need to be overcome
11. Problem Based Learning Overview and Resources -- Science examples
12. Constructivism Resources -- The case for problem-based learning
13. Social Constructivism: Case-based Instruction -- Case Study Methods of learning
14. Learner-Centered Classrooms, Problem-Based Learning, and the Construction of Understanding and Meaning by Students -- A Critical Area in Education
15. PBL Activities -- Great Examples
16. IN-SITES for BRAIN-COMPATIBLE LEARNING -- Revolutionary implications from cognitive neuro-science
17. IN-SITES for SERVICE LEARNING -- Combining service and academics, an excellent context for problem-based learning

LEARNWELL (Real-Life Problems)

18. LearnWell Certificates -- Many short on-line courses in health and ethics with projects; free or for credit via distance learning

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The TEACHER DEVELOPMENT NETWORK

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VII

What Is PBL?

Student-centered; faculty-facilitated

Problem-based learning is a pedagogical strategy for posing significant, contextualized, real world situations, and providing resources, guidance, and instruction to learners as they develop content knowledge and problem-solving skills (Mayo, Donnelly, Nash, & Schwartz, 1993). In problem based learning, students collaborate to study the issues of a problem as they strive to create viable solutions. Unlike traditional instruction, which is often conducted in lecture format, teaching in problem based learning normally occurs within small discussion groups of students facilitated by a faculty tutor (Aspy, Aspy, & Quimby, 1993, Bridges & Hallinger, 1991).

Because the amount of direct instructon is reduced in problem based learning, students assume greater responsibility for their own learning (Bridges & Hallinger, 1991). The instructor's role becomes one of subject matter expert, resource guide, and task group consultant. This arrangement promotes group processing of information rather than an imparting of information by faculty (Vernon & Blake, 1993). The instructor's role is to encourage student participation, provide appropriate information to keep students on track, avoid negative feedback, and assume the role of fellow learner (Aspy et al., 1993).

Evolution of Problem Based Learning

Although the roots of problem based learning can be traced back through inquiry training, John Dewey, and apprenticeships, recent evolution of the pedagogy was pioneered at Case Western Reserve University in the early 1950s. The structure developed by this university now serves as the basis of the curriculum at many secondary, post-secondary, and graduate schools including Harvard Medical School (Savery, 1994). In fact, over 80% of medical schools use the problem based learning methodology to teach students about clinical cases, either real or hypothetical (Vernon & Blake, 1993, Bridges & Hallinger, 1991).

Going Beyond Content

The ability to solve problems is more than just accumulating knowledge and rules; it is the development of flexible, cognitive strategies that help analyze unanticipated, ill-structured situations to produce meaningful solutions. Even though many of today's complex issues are within the realm of student understanding, the skills needed to tackle these problems are often missing from instruction. Typical problem solving taught in schools often tends to be situation specific with well-defined problem parameters that lead to predetermined outcomes with one correct answer. In these situations, it is often the procedures required to solve the problem that are the focus of instruction. Unfortunately, students skilled in this method are not adequately prepared when they encounter problems in which they need to transfer their learning to new domains, a skill required to function effectively in society (Reich, 1993).

Real-life problems seldom parallel well-structured problems; hence, the ability to solve traditional school-based problems does little to increase relevant, critical thinking skills students need to interact with life beyond classroom walls. Well-structured problems with their sterile environments in which there is only one right answer simply teach students about problem solving, not how to problem solve. In real life, we seldom repeat exactly the same steps to solve problems; therefore, the lockstep solution sequence taught in well-structured classroom problems is seldom transferable. Instead, real-life problems present an ever-changing variety of goals, contexts, contents, obstacles, and unknowns which influence how each problem should be approached. To be successful in their chosen career, students need practice solving ill-structured problems that reflect life beyond the classroom. This skill is the goal of problem based learning.

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San Diego State University

CSU Instructional Technology Initiatives
Office of the Chancellor
The California State University

Page Author - Diana Jones
Respond to forum: DCDPBL Faculty Develpoment Institute Forum

Revised: April 11, 1996
URL: http://edweb.sdsu.edu/clrit/learningtree/PBL/PBLadvantages.html

Center for Teaching

Problem Based Learning

The Center for Problem-Based Learning (PBL) and corresponding Web site was established in 1998 in conjunction with two grants from the Pew Charitable Trusts. Since that time, Samford took on the challenge to not only incorporate PBL into various undergraduate programs within the Schools of Arts and Sciences, Business, Education, Nursing and Pharmacy, but also to document best models of PBL practice in course portfolios. Many of the initial PBL efforts at Samford were documented in a newsletter, *PBL Insight: So solve, to learn, together*.

The PBL Center evolved into the Center for Teaching, Learning and Scholarship (**CTLS**) in 2003. Although the Center's focus has broadened, efforts to enhance student learning through the training, implementation and documentation of PBL and other methods of active, student-centered, collaborative, inquiry-based learning; and to share these practices with other educators continues.

The goal of the associated web pages is to provide administrators, faculty, students, and parents with detailed information on the components, implementation, assessment and documentation of PBL. Websites are specifically separated into PBL's **background**, **process**, **evaluation**, and **resources**. These pages also contain a guide to relevant workshops and conferences, materials, and links to other institutions that are using PBL in their undergraduate and/or graduate programs.

We hope you will find this information to be of assistance. If you have any suggestions or comments pertaining to this site, please contact the CTLS via e-mail (**msbaldwi@samford.edu**) or by telephone at (205) 726-4097.

Questions? Contact u

Project Based Learning

1. **Project-Based Learning: a Primer -- When students are challenged to get to work solving real-life problems, the whole world becomes a classroom. Here we offer a guide for getting started.**
2. **What is Project-Based Learning (PBL)?**
3. **Getting A Grip On Project-Based Learning: Theory, Cases and Recommendations**
4. **Project-Based Learning**
5. **Project Learning**
6. **PBL Research Summary: Studies Validate Project-Based Learning -- A growing body of academic research supports the use of project-based learning in schools as a way to engage students, cut absenteeism, boost cooperative learning skills, and improve test scores.**
7. **PBL Checklists -- Checklists to support Project Based Learning and evaluation**
8. **Criteria for Authentic Project-Based Learning**
9. **Overview: Project Based Learning**
10. **Project Based Learning Handbook**
11. **Defining Standards-Focused PBL**
12. **Coverage Versus "Uncoverage"**
13. **5 Classroom Projects -- These extended projects provide you with a framework for engaging in your own project-based experience**
14. **Project Based Learning**
15. **Suggested Readings and Links Around PBL**
16. **Designing Developing a PBL Unit**
17. **Our Model & Work With PBL -- Includes Sample Problems**
18. **Project Based Learning with Multi Media**
19. **Project, Problem, and Inquiry-based Learning**
20. **Project Examples**
21. **PBL Readings and Resources**
22. **Design Features for Project-Based Learning**
23. **Project Sites**

24. **Projects: Road Ahead (Project-Based Learning)**
25. **Assessing Through Senior Exhibitions and Projects**
26. **Thirteen Ed Online -- Many Science Projects**
27. **Project-Based Science**
28. **Mathematics & Science Projects**
29. **Math Projects**
30. **Math Ideas for Science Fair Projects**
31. **Social Studies Projects**
32. **Teacher Research: Social Studies Projects**
33. **ESL : Student Projects**
34. **English Projects**
35. **Projects in English**
36. **Gifted in the Regular Classroom? -- You Need Project Based Learning**
37. **Starting at the End | Project-based Learning**
38. **Problem-Based Learning**
39. **Inquiry-Based Learning**

Disadvantages of Problem Based Learning

As with all learning theories, there are advantages and limitations when creating or implementing problem based learning curriculum. These limitations revolve around six topics:

- the academic achievement of students involved in problem based learning,
- the amount of time required for implementation,
- the changing role of the student in the process,
- the changing role of the teacher in the process,
- generating appropriate problems, and
- valid assessment of the program and student learning.

Academic achievement

Few academicians doubt the ability of students schooled in problem based learning to exhibit strong reasoning and team building skills. Concern has been raised, however, over the breadth of content covered. Because the focus of problem based learning centers on a specific problem, academic achievement scores often favor traditional teaching methods when standardized test are used, but favor neither method when non-standardized forms of assessment are employed (Vernon & Blake, 1993). These measures include problem-solving ability, interpersonal skills, peer-faculty relationships, the ability to reason, and

self-motivated learning. In contrast, traditional instruction is judged better in the coverage of science content areas (Albanese & Mitchell, 1993, Vernon, 1995) and in evaluating students knowledge content. Although problem based learning tends to reduce initial levels of learning, it improves long-term retention (Farnsworth, 1994).

Time demands

Although students generally favor problem based learning courses, and their ability to solve real-life problems appears to increase over traditional instruction, instructors have not resoundly supported the movement toward this type learning. Contributing to this divergence is the time requirement placed upon faculty to assess student learning (Delafuente, Munyer, Angaran, & Doering, 1994; Vernon, 1995), prepare course materials, and allow students to complete the reduction in coverage of course material due to the inefficiency of problem based learning.

Role of the student

An unanticipated problem with problem based learning is the traditional assumptions of the student. Most students have spent their previous years assuming their teacher was the main disseminator of knowledge. Because of this orientation towards the subject-matter expertise of their instructor and the traditional memorization of facts required of students, many students appear to have lost the ability to "simply wonder about something" (Reithlingshoefer, 1992). This is especially seen in first year students who often express difficulties with self directed learning. (Schmidt, Henny, & de Vries, 1992).

Role of the teacher

Instructors in problem based learning curriculum need to alter their traditional teaching methods of lectures, discussions, and asking students to memorize materials for tests. In problem based learning, the instructor acts more as a facilitator than disseminator of information. As such, instructors focus their attention on questioning student logic and beliefs, providing hints to correct erroneous student reasoning, providing resources for student research, and keeping students on task. Because this role will be foreign to some teachers, they may have trouble breaking out of their past habbits.

Appropriate problems

Generating the proper question is the most critical aspect of PBL. Without problems that encompass both a large goal and specific objectives which students must find on their way to reaching the goal's solution, there is a good chance that important information will not be studied. In a study that correlated student directed study and faculty objectives, it was found that students did not stay on track and many important objectives were omitted (Dolmans, Gijselaers, & Schmidt, 1992). It has even been speculated that if students divert from their anticipated directions during their solution generation, they may completely miss the main content if not redirected by their instructor (Mandin, 1995).

Student assessment

Problem based learning differs from traditional instruction in a variety of ways, and therefore student knowledge and achievement may be better measured with alternate assessment methods. These methods include written examinations, practical examinations, concept maps, peer assessment, self assessment, facilitators/tutor assessment, oral presentations, and written reports. More information on assessment can be found in this accompanying article.

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Learner-Centered Classrooms, Problem-Based Learning, and the Construction of Understanding and Meaning by Students

To create an effective learning situation in the classroom, Combs (1976) says that three characteristics are needed:

1. The atmosphere should facilitate the exploration of meaning. Learners must feel safe and accepted. They need to understand both the risks and rewards of seeking new knowledge and understanding. The classroom must provide for involvement, interaction, and socialization, along with a business-like approach to getting the job done.
2. Learners must be given frequent opportunities to confront new information and experiences in the search for meaning. However, these opportunities need to be provided in ways that allow students to do more than just receive information. Students must be allowed to confront new challenges using their past experience without the dominance of a teacher/giver of information.
3. New meaning should be acquired through a process of personal discovery. The methods used to encourage such personal discovery must be highly individualized and adapted to the learner's own style and pace for learning.

Problem-based learning is the type of classroom organization needed to support a constructivist approach to teaching and learning. Savoie and Hughes (1994), writing about a process that they used to design a problem-based learning experience for their students, describe the following actions for creating such a process:

- Identify a problem suitable for the students.
- Connect the problem with the context of the students' world so that it presents authentic opportunities.
- Organize the subject matter around the problem, not the discipline.
- Give students responsibility for defining their learning experience and planning to solve he problem.
- Encourage collaboration by creating learning teams.
- Expect all students to demonstrate the results of their learning through a product or performance.

In *A Different Kind of Classroom* (1992), Robert Marzano makes six assumptions about creating a learning-centered classroom:

1. Instruction must reflect the best of what we know about how learning occurs.
2. Learning involves a complex system of interactive processes that includes five types of thinking - the five dimensions of learning.
3. What we know about learning indicates that instruction focusing on large, interdisciplinary curricular themes is the most effective way to promote learning.
4. The K-12 curriculum should include explicit teaching of higher-level attitudes and perceptions and mental habits that facilitate learning.
5. A comprehensive approach to instruction includes at least two distinct types of instruction: teacher-directed and student-directed.
6. Assessment should focus on students' use of knowledge and complex reasoning rather than their recall of low-level information.

VIII

Project-Based and Problem-Based: The same or different?

The terms *project-based learning* and *problem-based learning* are each used to describe a range of instructional strategies. The breadth of their respective definitions, their conceptual similarity, and the use of the shorthand term *PBL* result in some confusion in the literature. A brief survey of professional dialogue, Internet postings, and literature on project-based and problem-based learning reveals both similarities and differences between the two.

Similarities

As defined in the literature, project-based learning and problem-based learning share several characteristics. Both are instructional strategies that are intended to engage students in authentic, "real world" tasks to enhance learning. Students are given open-ended projects or problems with more than one approach or answer, intended to simulate professional situations. Both learning approaches are defined as student-centered, and include the teacher in the role of facilitator or coach. Students engaged in project- or problem-based learning generally work in cooperative groups for extended periods of time, and are encouraged to seek out multiple sources of information. Often these approaches include an emphasis on authentic, performance-based assessment.

Differences

Despite these many similarities, project- and **problem**-**based** **learning** are not identical approaches. Project-**based** **learning** tends to be associated with K-12 instruction. **Problem**-**based** **learning** is also used in K-12 classrooms, but has its origins in medical training and other professional preparation practices. (Ryan et al).

Project-**based** **learning** typically begins with an end product or "artifact" in mind, the production of which requires specific content knowledge or skills and typically raises one or more problems which students must solve. Projects vary widely in scope and time frame, and end products vary widely in level of technology used and sophistication. The project-**based** **learning** approach uses a production model: First, students define the purpose for creating the end product and identify their audience. They research their topic, design their product, and create a plan for project management. Students then begin the project, resolve problems and issues that arise in production, and finish their product. Students may use or present the product they have created, and ideally are given time to reflect on and evaluate their work. (Crawford, Bellnet website, Autodesk website, Blumenfeld et al). The entire process is meant to be authentic, mirroring real world production activities and utilizing students' own ideas and approaches to accomplish the tasks at hand. Though the end product is the driving force in project-**based** **learning**, it is the content knowledge and skills acquired during the production process that are important to the success of the approach.

Problem-**based** **learning**, as the name implies, begins with a **problem** for students to solve or learn more about. Often these problems are framed in a scenario or case study format. Problems are designed to be "ill-structured" and to imitate the complexity of real life cases. As with project-**based** **learning**, **problem**-**based** **learning** assignments vary widely in scope and sophistication. The approach uses an inquiry model: students are presented with a **problem** and they begin by organizing any previous knowledge on the subject, posing any additional questions, and identifying areas they need more information. Students devise a plan for gathering more information, then do the necessary research and reconvene to share and summarize their new knowledge. Students may present their conclusions, and there may or may not be an end product. Again, students ideally have adequate time for reflection and self-evaluation. (Duch, Delisle, Hoffman and Ritchie, Stepian and Gallagher). All **problem**-**based** **learning** approaches rely on a **problem** as their driving forces, but may focus on the solution to varying degrees. Some **problem**-**based** approaches intend for students to clearly define the **problem**, develop hypotheses, gather information, and arrive at clearly stated solutions. (Allen). Others design the problems as **learning**-embedded cases which may have no solution but are meant to engage students in **learning** and information gathering. (Wang).

In practice, it is likely that the line between project- and **problem**-**based** **learning** is frequently blurred and that the two are used in combination and play complementary roles. Fundamentally, **problem**- and project-**based** **learning** have the same orientation: both are authentic, constructivist approaches to **learning**. The differences between the two approaches may lie in the subtle variations. There are at least two possible continua of variation in these type of **learning** approaches. One is the extent to which the end product is the organizing center of the project. On one end of this continuum, end products are elaborate and shape the production process, such as a computer animation piece which requires extensive planning and labor. On the other end, end products are simpler and more summative, such as a group's report on their research findings. The former example is best described as project-**based** **learning**, where the end product drives the planning, production, and evaluation process. The latter example, where the inquiry and research (rather than the end product) is the primary focus of the **learning** process, is a better example of **problem**-**based** **learning**.

A second continuum of variation is the extent to which a **problem** is the organizing center of the project. On one end of this continuum are projects in which it is implicitly assumed that any number of problems will arise and students will require **problem**-solving skills to overcome them. On the other end of this continuum are projects that begin with a clearly stated **problem** or problems and require a set of conclusions or a solution in direct response, where "the problematic situation is the organizing center for

the curriculum.". Here again, the former example typifies project-**based** **learning**, where the latter is best described as **problem**-**based** **learning**.

Prepared for the Challenge 2000 Multimedia Project by
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Project, Problem, and Inquiry-based Learning

What are **problem**, project, and inquiry **based** **learning**?

How are these approaches alike and different?

How do I choose the best approach for my technology-rich classroom?

A project-based approach is enjoyable for everyone involved. Can fun activities really promote learning? Over the past decade an increasing number of studies have shown the positive impact of project-based learning on achievement.

Read Start With the Pyramid from Edutopia. Then, read Project-Based Learning Research from Edutopia. Explore one of the studies discussed in the article. Explore Project-Based Learning: At a Glance from Edutopia. Read one of their articles.

Explore the Approaches

Project-based learning, problem-based learning, and inquiry-based learning all three closely relate to the information processing approach. They all fit well with technology-rich learning environments where the focus is not on the hardware and software, but on the learning experience. In each case, technology is used to facilitate learning. It may be a tool to organize ideas (such as Inspiration), search for current information (such as an online news source), or present ideas (such as PowerPoint presentations). However the focus of learning environment is the student's excitement about solving a problem or addressing an issue they find meaningful.

Read Introducing Project-Based Learning from Edutopia.

Be sure to read all eight pages. These will lead you through an example project.

Project-based Learning

An approach to learning focusing on developing a product or creation. The project may or may not be student-centered, problem-based, or inquiry-based.

Explore the following websites as needed for more information:

- Project-based Learning
- Project-based Learning Overview
- Challenge 200 Project-based Learning and Multimedia Web Site
- The Project Approach
- Project-based Learning Checklists - 4teachers
- The Guide on the Side

Problem-based Learning

An approach to learning focusing on the process of solving a problem and acquiring knowledge. The approach is also inquiry-based when students are active in creating the problem.

Explore the following websites as needed for more information:

- **Problem-Based Learning** - Schools of California
- **Problem-based Learning** - Southern Illinois School of Medicine
- Center for **Problem-Based Learning** - Math and Science
- PBL Archives

Inquiry-based Learning

A student-centered, active **learning** approach focusing on questioning, critical thinking, and **problem**-solving. It's associated with the idea "involve me and I understand."

Explore the following websites as needed for more information:

- Information Inquiry for Teachers 
- Inquiry-**based Learning**. This page provides a wealth of information on inquiry and inquiry-**based learning**.
- The Inquiry Page. This page focuses on a model for inquiry-**based learning**. Their philosophy is that **learning** begins with questions. The process includes ask, investigate, create, discuss, and reflect. You can also search for thematic units.
- Inquiry-**based Learning** and Teaching. This project focuses on science and museums, but provides many good examples. Check out the tree ring and species examples.
- Exploratorium: Inquiry. This page provides overview of inquiry-**based learning**. Check out their projects.
- Teach-nology Inquiry Links. This page provides a good starting point for additional information.

The "Best" Approach

The best approach is the one that works for you in your classroom. Many teachers have chosen to blend these approaches together. Others vary the approach depending on the **learning** need. Explore the ThinkQuest projects for some excellent examples of all three of the approaches discussed. You can find elements of each approach in many of the entries.

Compare Project, Problem, and Inquiry-based Learning

After exploring the sites above, create a chart comparing each approach. Select a topic and discuss how it might be approached differently using each technique.

Explore ThinkQuest projects and discuss which approach might work best for a particular project.

VIII

PROBLEM-BASED LEARNING (PBL)

This is available in Acrobat 4.0 here

PBL Quick Facts:

- What is PBL? Is it a new methodology? PBL is not a new model of instruction. Plato and Socrates required that their students think, retrieve information for themselves, search for new ideas and debate them in a scholarly environment. However, this process differs from the teacher-dominated approach used in most educational settings.

- Where did PBL come from? PBL was officially adopted as a pedagogical approach in 1968 at McMaster University, a Canadian medical school. (Neufeld & Barrows, 1974), because students were unable to apply their substantial amount of basic scientific knowledge to clinical situations.

- How Does it Work? Students in small groups investigate and analyze problems/scenarios. Using an organizer process of; 1) identifying the FACTS in the problem/scenario; 2) generating (un-criticized) their IDEAS about the scenario/problem and identifying just "what is the problem?"; 3) finally identifying the things they have to LEARN about - in order to test their hypotheses (ideas).

- Why is this an effective approach? The use of this three step inquiry-organizer helps students become familiar with a scientist's reasoning process, to fill the gaps in their own knowledge base, and to use their newly acquired knowledge to refine or discard their ideas thus generating a whole new set of LEARNING NEEDS. This model has been successfully applied to science instruction at all grade levels.

PBL places students in small groups and provides a means by which they can investigate real problems. According to Fincham et al. (1997), "PBL does not present a new curriculum but rather the same curriculum through a different teaching method," (p. 419).

How is problem-based learning different from project-based learning?

Project-Based Learning: Teacher A has her class design and build a city by the end of the semester. The task is defined for them at the beginning with the inquiry bounded. They discuss and explore various aspects of cities, architecture, sewer and other systems etc. Students identify what they believe are the most effective ways to build their city within the boundaries they are given in order to complete their project.

Problem-Based Learning: Teacher B has a city designed and built by students as her final outcome the students may not know what that outcome is. The inquiry is very open allowing the students to discover aspects that may not have been apparent. She introduces various scenarios/problems to her students throughout the semester. Each scenario deals with a different aspect of the city. An example would be sewage systems. Given a scenario related to sewage, students identify the FACTS, brainstorm IDEAS about what the problem really is and what they think about the situation. The LEARNING NEEDS they identify for themselves may take them into: How various systems work, alternative sewage systems, environmental issues, the role that soil plays in waste disposal, the impact on the water supply, waste disposal legislation, debates about the pros and cons of public/private operations, water contamination and/or purification etc. generating new FACTS, refining IDEAS and generating new LEARNING NEEDS. The next scenario/problem may take them in-depth into different aspects of water purification systems, building on the knowledge they gained in the previous scenario/problem. At the end of the semester, the city is built, and in-depth research has been done on each piece of the city's infrastructure.

How do I safeguard the integrity of the process? The integrity of the process depends to a great extent on the groups themselves. Groups are kept small, approximately 5 students and a facilitator. At the beginning of the process, group norms are set by the students in the group. Norms include but are not limited to: Respect for everyone's ideas – no idea is "stupid"; not interrupting someone else while they are speaking; in other words "what should be OK in this process and what should not be OK – the rules of the game".

IDEAS are organized and then "rephrased" into a "testable" form (hypothesis). At this point the "problem" is also identified. The next step is to generate LEARNING NEEDS (what we need to know) that are prioritized and then divided among the group participants for investigation. Each group member researches their part and the next day the group meets to discuss and share the new information. This process generates a refinement of the prior ideas/hypotheses and generates a new set of learning needs. Assessments are given to the individuals in the group and the resulting grades are NOT for the group as a whole - the sharing of information becomes an imperative and because of this the group becomes a powerful force for mutual dissemination.

What part do hands-on instructional materials and kits play in PBL? Hands-on materials and kits are powerful tools to learn concepts and to test hypotheses in order to refine IDEAS. E.g. a scenario/problem that has a learning need about why a seed won't grow could utilize a kit to test soil samples, or water samples, or a weather study could result.

Teachers can anticipate what may be needed so that materials are on hand. In addition, art or the performing arts can be integrated as an outcome; field sketching, clay, botanical drawing, dance, plays, robot building, etc. The process can be as creative for the teacher as for the students.

Problem-Based Learning in Science Classrooms

Students are at the center of learning when teachers implement PBL. First, a problem or scenario is presented to stimulate student interest. Students work in small groups to investigate the problem. With very young children, the teacher may keep the class as a large group for fact-finding, idea generation and learning needs identification. As the process progresses, ideas are challenged by other group members or by the teacher if necessary. The process is cyclical and repeated several times as new information is learned and ideas have been modified to generate new learning needs. It should be noted that solving the problem is not the most important objective, the power of PBL is found within the learning process itself through student-directed inquiry. Scientific facts and concepts are not taught directly, but integrated within the scientific process. Also integrated within the process is reading, writing, vocabulary and if desired, mathematics and a host of other disciplines.

When investigating a PBL scenario, students assume the role of scientist. Effective problems are those that engage student interest and motivate them to probe for deeper understanding of science concepts. Good problems ask students to formulate ideas or judgments based on facts that may be prior knowledge, information given in the scenario, and logic. Problem-based learning usually includes several steps.

The five-step model in the chart below identifies these steps:

1. Problem is presented and read by group member, while another acts as scribe to mark down FACTS as identified by group.
2. Students discuss what is known (the facts).
3. Students discuss what they think and identify the broad problem

   (brainstorm their ideas and formulate their hypotheses).

4. Students identify their learning needs (what they need to learn in order to prove or disprove their ideas).
5. Students share research findings with their peers, then recycle steps 2-4

Teachers take on a minimal role when presenting PBL scenarios. They use open-ended questions to foster student metacognitive growth. If necessary, ask questions like: What's going on here? What do we need to know more about? What is your evidence? A wait-time is essential to allow the student to process the information and formulate their ideas – they should not be rushed. As students participate in PBL over time, they become self-

directed learners who are able to ask their own questions, and identify what they need to know to continue their learning.

Creating PBL Scenarios

Ideas for PBL scenarios can come from almost anywhere; literature, television programming, news programs or newspapers articles. Wonderful PBL scenarios can be created by changing traditional lessons into problem-based inquiry learning. These lessons should be aligned with the curriculum for your grade level and embedded with desired learning outcomes. When creating or identifying scenarios consider the following components:

- A loosely structured case or prompt embedded with links to desired learning outcomes i.e. standards (national, state or local).
- Small group cooperative learning is best, but find the model that works best for you.
- In the example provided of a dental education case from Malmo, Sweden – the one sentence case drives their curriculum for weeks (see schematic in Appendix).
- Use hands-on kits and instructional materials – to test hypotheses and generate new facts based on scientific experimentation.
- Learning is very open. In the case provided, "Buzz-saw Terror" if students have an idea that the insect is an ant and you as a teacher know it isn't – it's OK if they spend time investigating ants – eventually they are going to find that ants don't build mounds like the one described. When they do, they're back on track and they not only learn about the insect that does build the mound – they also have learned about ants, which may or may not have been a teacher-desired outcome in the first place.

We have included on this website, a variety of PBL scenarios that have been successfully implemented in science classrooms. Feel free to use them as they are written or change them to meet the needs of your students or your science curriculum. Some of these cases are short and can be completed within 2-3 class sessions, other cases require 1-4 weeks. In some instances, students at different grade levels can use the same case. The beauty of PBL is that students use their prior knowledge when developing ideas and formulating those ideas into hypothesis that can be tested. The advanced level of a high school student will result in a deeper, more complex investigation than would be done by a younger student.

Note: *The Center For Craniofacial Molecular Biology of the USC School of Dentistry graduated their first completely PBL trained dental class of 1999 last May. Their entire curriculum was delivered through PBL cases that were based on identified outcomes from the traditional dental school program on the main campus. Currently there are four PBL classes at CCMB, new PBL cases are introduced every two weeks. During the recent National Boards, nine students out of thirteen in the Class of 2001 scored over the 90th percentile.*